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Social drinking and sober cognitive functioning.

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SOCIAL DRINKING AND SOBER COGNITIVE FUNCTIONING

By

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Abstract

This study used a quasi-experimental design to test the hypothesis that social drinking at greater than usual levels of consumption produces decrements in sober abstract functioning. The Shipley Institute of Living Scale (SILS) Vocabulary and Abstraction subtests and the Employee Aptitude Survey (EAS) Symbolic Reasoning and Verbal Reasoning subtests were utilized to assess cognitive functioning. Thirty-six participants (19 male, 17 female) were assigned to either a non-drinking control group (n=18) or an alcohol consumption group (n=18). Alcohol group participants attended four Saturday evening parties on a bi-weekly basis. On two of these occasions they were allowed to consume alcohol (the second and fourth) and on two they were not (first and third). At the alcohol available parties participants were allowed access to either their usual quantity consumed per occasion (QPO), or to a 33% increase over their QPO. Alcohol participants were tested 36 hours after their parties and were to remain abstinent during that time. Control participants were tested on a bi-weekly basis and were asked to remain abstinent for 48 hours prior to testing. Results indicate that alcohol consumption at a level consistent with social drinking, as well as consumption above QPO, produces changes in sober cognitive functioning. Some verbally dependent tasks appear to be enhanced by exposure to alcohol (EAS Verbal Reasoning and SILS Vocabulary) while some tasks

requiring abstract functioning (EAS Symbolic Reasoning and SILS Abstraction) appear to suffer following exposure to alcohol. The negative impact of alcohol is subtle, is not apparent on a verbally based test of abstract functioning, and seems to have a beneficial effect on some cognitive functions. These results can best be explained by asserting that social drinking interferes with a cognitive process other than abstract functioning. Social drinking seems to interfere with the capacity to remember and apply novel information to a task. Results from earlier studies can be seen as reflecting this interference with 'resource allocation'. Implications for the design of future research studies are discussed.

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CHAPTER I

Introduction

In 1919 a book written by Ferdinand C. Iglehart warned that the consumption of alcoholic beverages, even in small quantities, was a hazard to social stability, individual health, and the immortal soul of every imbiber. This was standard fare for the Temperance literature of the day, but Mr. Iglehart went beyond that when he devoted an entire chapter to the psychological effects of alcohol consumption. He cited the work of several luminaries in the history of psychology and science - Wundt, von Helmholtz, Kraepelin and others - and claimed that they had scientifically shown that alcohol interfered with sober cognitive functioning, even when taken in small doses (Iglehart, 1919, pp. 1-32).

The past 68 years have witnessed a tremendous amount of work dedicated to understanding the effects of alcohol consumption. The sheer volume and variety of the related research is staggering, but in some ways it has not significantly advanced our knowledge. In particular, we still do not know if Iglehart's contention, that moderate drinking results in decreased intellectual performance, is accurate. This is not because of a lack of interest, however. Aside from the early efforts noted by Iglehart, contemporary psychological research has been investigating the effects of social drinking on sober cognitive performance since 1977.

Because the focus here is on social drinkers and the extent, if any, to which their alcohol consumption interferes with sober cognitive functioning, the first task is to define social drinking. By a social drinker I mean any individual who consumes alcohol but is neither alcohol dependent nor an alcohol abuser, as defined by the DSM-III-R (1987)[1]. It is important to recognize that this definition consists of both a physiological and a functional component. As a result, a social drinker is one who has not developed a significant tolerance to alcohol and who's alcohol consumption does not interfere with his or her adequate daily functioning.

Including this functional condition in the definition places some restriction on the extent to which social drinking can interfere with sober cognitive functioning. Obviously, if social drinkers function adequately then any decrements in cognitive functioning cannot fall into the clinically impaired range. Thus, the interference that alcohol consumption might produce in social drinkers must, by definition, be fairly subtle.

The contemporary theoretical justification for examining this issue rests on what has been called the Continuum Theory or continuity hypothesis. This position was first put forward by Ryback in 1971 and holds that, as the name suggests, the cognitive deficits seen in Alcohol-Korsakoff

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[1]Please refer to Appendix A for a detailed description of the criteria required to meet these diagnoses.

patients and alcoholics fall along a continuum of impairment. It maintains that these deficits result from alcohol consumption, that they develop progressively over time, and, implicitly at least, that there is a dose-response relationship between alcohol consumption and sober cognitive deficits. Given these premises, the theory can be, and in fact has been, extended to predict the presence of sober cognitive decrements in social drinkers.

In 1977 Parker and Noble first attempted to test the Continuum Theory using a sample of social drinkers. Briefly, their procedure consisted of selecting a random sample of males listed in a suburban community telephone book and mailing them a drinking history questionnaire. Aside from requesting respondents' amount and pattern of alcohol consumption, demographic characteristics, and medical information, the questionnaire asked that it be returned to the researchers. Once the completed questionnaires were returned, responders were screened for eligibility (criteria for acceptance were: No history of CNS trauma; no current psychoactive medication use; between 30 and 60 years of age.). Those deemed eligible were contacted by phone and requested to participate in a 90 minute individual test session. This session consisted of the participant completing the Shipley-Hartford Institute of Living Scale (SILS), the Halstead Category Test, the Wisconsin Card Sorting Test (WCST), and a multitrial free-recall learning

test (see Parker, Alkana, Birnbaum, Hartley, & Noble, 1974 for a detailed description of this test). Fifteen separate measures of cognitive functioning were derived from these tests and a total of 102 men, with a mean age of 43, completed the procedure.

Parker and Noble (1977) conducted age-partialled correlation analyses between the three representative drinking variables [current quantity consumed per occasion (QPO), current frequency of drinking, and total lifetime consumption] and scores on the various measures of cognitive functioning. Using one-tailed t-tests, nine significant correlations were found, all of which reflected decreased cognitive performance with increased QPO. They concluded that "The processes of abstraction, adaptive abilities and concept formation appear to be associated with the amount of alcohol consumed per drinking occasion." (p. 1229).

They also split their sample into heavy and nonheavy drinking groups and re-ran the age-partialled correlation analysis for each. Based on these results, Parker and Noble concluded once more that QPO was associated with poorer performance in shifting ideas, in concept formation, and in adaptive abilities.

The importance of this study lies in the fact that it was the first contemporary effort in this area. Research with alcoholics had suggested that, rather than QPO alone, a number of consumption variables and their interactions could

best predict sober cognitive deficits (Eckardt, Parker, Noble, Feldman, & Gottschalk, 1978). Surprisingly, although Parker and Noble (1977) provided some evidence in support of the Continuum Theory, the consumption variables which predicted deficits in the alcoholic did not seem to apply to the social drinker.

Parker's and Noble's (1977) study has been criticized on statistical and methodological grounds, but for the most part their findings and conclusions seem to have been accepted as valid. Both Eckhardt and Ryback (1981) and Parsons (1986) reviewed the study and pointed out two drawbacks. The first was their inappropriate use of one-tailed *t*-tests given the lack of explicit hypotheses. The second was their failure to correct for the effects of multiple statistical comparisons. Despite these problems, both reviews accepted Parker's and Noble's (1977) findings as being essentially valid. Unfortunately, when Parker's and Noble's results are re-calculated using both two-tailed *t*-tests and the Bonferroni procedure to correct for multiple comparisons (Cohen & Cohen, 1975, p. 157), their conclusions are much less convincing: Only three of their reported correlations retain their statistical significance, indicating poorer cognitive performance with increased QPO.

There are also problems with Parker's and Noble's (1977) choice of statistical analysis and their sample selection. Their use of partial correlations is problematic because such

an analysis can produce results which more accurately reflect the idiosyncracies of the sample rather than a population effect (Schoenberg, 1985).[2] In order to avoid such a pitfall, Schoenberg (1985) recommended the use of unstandardized metric measures (i.e. unstandardized regression coefficients). The implication for Parker's and Noble's (1977) study is that their conclusions might well be based on a statistical artifact, particulary when their biased sample is considered. The nonrandom character of their sample threatens both the internal validity and generalizability of the results. That is, in nonrandom sample selection , as in survey designs such as Parker's and Noble's (1977), the probability of including some uncontrolled variable which is correlated with the identified independent variables, is unknown. Thus, the validity of observed findings is threatened.[3]

The point of the above discussion is that the findings described in the first contemporary investigation of sober cognitive decrements in social drinkers are not very convincing. The authors' biased sample, choice of statistical analysis, and the application of that analysis,

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[2]Schoenberg (1985) also notes that comparisons of partial correlations across samples is particularly risky and likely to result in misleading conclusions. Such a cautionary note is worth keeping in mind when considering later studies that utilized similar analyses in attempting to confirm Parker's and Noble's findings.

[3] For a more detailed discussion of the hazards of sample selection bias, see Berk (1983).

all detract from the strength of Parker's and Noble's conclusions. Nonetheless, early in 1980 Parker and Noble again published a study dealing with the sober effects of social drinking.

In their second study Parker and Noble (1980) asserted that the negative association between QPO and cognitive functioning had been established and that their purpose was to assess the effects of age on this relationship. Interestingly, they did not re-sample the population of social drinkers. Instead, they re-analyzed the data they had collected in 1977 and based their conclusions on this reanalysis. First they ran two correlation analyses viewing the relationship between measures of cognitive functioning and QPO and between the cognitive measures and age. Like their 1977 study, they did not correct for multiple comparisons. When this is done, the number of significant correlations with age is reduced from 11 to four, only one of which is a correlation with QPO. However, in each case the direction of the correlation indicates a decrease in cognitive performance as QPO or age increased.

They also conducted two separate series of bivariate regressions (one for the older group, one for the younger) using each cognitive measure as the dependent variable and QPO as the independent variable. Unfortunately for their results, when their regression analyses are corrected for

multiple comparisons none of the results meet the .001 probability level necessary for statistical significance.

There are three points worth raising in regard to Parker's and Noble's (1980) conclusion that social drinking has a greater negative impact on the cognitive functioning of older individuals. First, they found that on two of their measures QPO appeared to have a greater negative impact on the older group than on the younger group, but on 11 other cognitive measures no such effect was found. It seems questionable on the basis of these results to conclude that alcohol consumption has a greater negative impact on older than younger individuals.

Second, the older group tended to have a higher QPO than the younger group. Given this, and given that QPO is expected to be negatively associated with cognitive functioning, it should not have been surprising that on some measure of cognitive functioning the younger group performed better than the older group.

The third, and final, point is not so much a problem as an example of serendipity. Comparing the correlations reported in their 1980 study with those from the 1977 study reveals that age was acting as a suppressor variable on the association between QPO and cognitive functioning. This is consistent with the point that QPO accounts for variance in cognitive functioning independent of age. It is ironic that comparing these two studies succeeds in providing evidence

which supports the hypothesis while neither alone, despite their claims, convincingly did so.

Contemporaneously with Parker and Noble (1980), Jones and Jones (1980) reported a well designed and cogently presented study whose purpose was to determine if alcohol consumption was related to social drinkers' performance on a memory task. They found that 'short-term' performance was poorer in older women and in women who were labeled moderate drinkers. As well, heavier drinkers performed more poorly on memory tasks than did lighter drinkers, even before acute exposure to alcohol.

Although their's was a well designed and executed study, Jones and Jones (1980) only tangentially addressed the issue of sober cognitive decrements resulting from social drinking. Their main finding was that moderate drinkers (a term which they left undefined) had a greater susceptibility to the acute effects of small doses of alcohol than did light drinkers. While these results do not directly answer the question of whether or not there is a sober cognitive effect from social drinking, they do provide some rationale for expecting there to be such an effect.

A third study investigating the effects of social drinking on cognitive functioning was also published in 1980. In this study Parker, Birnbaum, Boyd, and Noble (1980) examined a sample of 45 young (21 - 30 year old), male uni[illegible]sity students. Each student completed a drinking

history questionnaire and the SILS while sober. On the basis of the questionnaire results three alcohol consumption variables were calculated for each participant: Lifetime consumption, current frequency of consumption, and QPD. The authors then calculated age and education partialled correlation coefficients for all drinking variables with all cognitive functioning scores. They also conducted four multiple regression analyses using cognitive functioning measures as the dependent variable and the three drinking variables as predictors. By controlling the entry of predictors into the equations they were able to identify the extent to which each consumption variable was related to the dependent measure while the other two consumption variables were held constant.

This study (Parker et al, 1980) is more convincing than earlier attempts because it utilized multiple regression analyses. They found that when lifetime consumption and frequency of consumption were held constant, QPD was negatively related to, and accounted for a significant amount of variance in, each of the four cognitive measures.

MacVane, Butters, Montgomery, and Farber (1982) were the first to attempt an independent confirmation of the initial Parker and Noble (1977) study. A total of 106 participants met the inclusion criteria and completed the procedure. Using the same criteria as Parker and Noble (1977), MacVane

et al (1982) divided their sample into a heavy drinking group (n=58) and a light-moderate drinking group (n=48).

They conducted univariate analyses of variance (ANOVA) with group as the independent variable and each cognitive measure and drinking variable as the dependent variable. The ANOVA's reflected significant differences between the two groups on all of the drinking variables ($p<.001$), but no group differences on the cognitive measures. They also conducted a partial correlation analysis, with age and Vocabulary score partialled, for the total sample and for each of the drinking groups. Needless to say, the problems inherent in claiming statistical significance without accounting for the effects of multiple comparisons apply just as much to MacVane et al (1982) as they do to Parker and Noble (1980). Thus, of all the partial correlations they calculated (90), and of the 13 coefficients reported as significant, only one retains its significance after correcting for multiple comparisons.

Nevertheless, MacVane et al (1982) concluded that their results did replicate the negative relationship between QPD and cognitive functioning reported by Parker and Noble (1977). However, they also pointed out that methodological and conceptual issues prevented them from concluding that the evidence supported the Continuum Theory as applied to social drinkers. Specifically, there was no evidence of a dose-response relationship between alcohol consumption and

cognitive decrements (i.e. there were no significant group differences on measures of cognitive functioning).

In their final conclusion MacVane et al (1982) noted that the correlations they found were generally low (only one exceeded .40). That, coupled with the lack of controls for abstinence, led them to state that caution was needed in interpreting the results and that more research was necessary before providing public information concerning the safety of social drinking.

MacVane's et al (1982) study prompted the editors of the Journal of Studies on Alcohol to request responses from Parker (1982) and Parsons and Fabian (1982). These two reactions present an interesting example of how the results of a single study can be interpreted as supporting somewhat divergent conclusions.

Not surprisingly, Parker (1982) hailed the MacVane et al (1982) study as an independent confirmation of her own work. She asserted that five separate studies had all provided evidence supporting the contention that sober cognitive decrements increased as QPO increased and that the existence of this association was no longer a viable question for researchers to address. Rather, she asserted that it was time to understand this relationship. Presumably in an effort to advance this understanding, Parker (1982) attempted to dispel some misconceptions about the research findings and to provide a theoretical framework for them. In the former

endeavour she pointed out that there was no evidence to suggest that social drinking produces brain damage or clinical levels of impairment. Rather, she identified the research issue under examination as the extent to which social drinking can explain normal variations in cognitive performance. She also pointed out that the permanence of such decrements had yet to be investigated, and so any claims regarding permanence were speculative.

In the latter endeavour Parker put forward a 'carryover' model for explaining the presence of cognitive decrements in social drinkers. In her words, "... acute doses of alcohol produce perturbations in the central nervous system, which does not return to normal as soon as alcohol leaves the bloodstream." (Parker, 1982, p. 172). Put another way, she provided a causal explanation by stating that alcohol produces, or creates, some interference in CNS functioning and that this interference, once established, does not depend on the continued presence of alcohol in the bloodstream in order to exert its disruptive influence. She also noted that the level of intoxication (basically QPO) would be an important variable. Whether this was important because she saw a dose-response relationship or because she saw it as reflecting a critical threshold phenomenon, or perhaps both, was left unclear.

Parker (1982) continued her comment by pointing out that a multiple regression analysis would have been more sensitive

than the between groups analyses conducted by MacVane et al (1982) given that alcohol consumption is more accurately a continuous variable rather than a categorical variable. In this way MacVane's et al (1982) conclusion that there was no evidence supporting a dose-response relationship might have been premature. Such a comment by Parker was quite appropriate and reflected an awareness of methodological issues that were still of concern to Schoenberg (1985) some years later.

The second commentary was provided by Parsons and Fabian (1982). These authors noted that the MacVane et al (1982) results were superficially consistent with Parker's and Noble's (1977), but upon closer examination could not be construed as supportive. They pointed out that on the only cognitive measure that the two studies had in common (WCST), the results were quite different.

Like Parker, Parsons and Fabian (1982) also attended to the between group analyses. Unlike Parker, they suggested that MacVane et al (1982) could have usefully compared the upper and lower thirds or quartiles of their sample in searching for differences in cognitive functioning. However, Parsons and Fabian (1982) went on to say that even if such a comparison of extremes were carried out, they would expect no significant differences to be revealed. This expectation was based on the then new data which they presented.

Before discussing Parson's and Fabian's (1982) results, I want to point out that these authors seemed to have missed the point made by Parker (1982) with regard to data analysis. That is, group differences analyses are likely to be insensitive to subtle changes in sober cognitive functioning. Thus, Parsons' and Fabian's analysis could mislead them into drawing invalid conclusions.

Parsons and Fabian (1982) reported their own attempt to replicate Parker's and Noble's (1977) and MacVane's et al (1982) results based on three samples of participants; alcoholic women (n=51), community women (n=54), and college students (n=81). All participants were given the SILS and a detailed drinking questionnaire. On the basis of the questionnaire results each sample was split into 'heavy' and 'light' drinking groups. Age- and education-partialled correlations between QPO and the three cognitive measures from the SILS (Vocabulary, Abstraction, and Conceptual Quotient scores) were calculated for the total of each sample and for the separate drinking groups from each sample. They then compared the cognitive performance of those age and education matched individuals who, based on QPO, composed the upper and lower extremes of the groups. In this latter analysis they found no significant differences. In the former analysis, they found that, in the total samples and in the 'heavy' drinking groups, cognitive performance was consistently and negatively related to QPO. For the 'light'

drinking groups, however, no such consistency was apparent and no correlations were reported to be significant.

On the face of it, Parsons' and Fabian's (1982) results seem to detract somewhat from the confidence Parker puts in the negative relationship between sober cognitive functioning and QPD. Their results were certainly inconsistent with expectations based on the Continuum Theory. That is, they found that the cognitive effects of 'light' drinking were neither consistent nor significant in these samples even though an effect was found in the 'heavy' drinkers. They also reported a 'frequency of consumption' measure and found that, in the college sample, for the total and for the 'heavy' drinkers cognitive functioning was positively and significantly related to frequency of alcohol consumption.

Overall, the direction and magnitude of correlations between QPD and cognitive performance for 'light' drinkers, in all studies, might reasonably lead some to question the importance of continuing this research. However, as noted by Parsons and Fabian (1982), all of the studies reviewed so far did show a consistent finding: alcohol consumption was negatively correlated with cognitive functioning, with heavier social drinkers providing correlations of greater magnitude.

Both Parker (1982) and Parsons and Fabian (1982) concluded their comments by calling for further research. Such research was to include methodological controls (i.e.

screens for alcoholism, BAC readings prior to testing) in order to minimize the disruptive effects of confounding variables. While neither mentioned the importance of choosing the appropriate statistical analysis, the point was seemingly taken by Parker, who published yet another reanalysis of her 1977 data.

Parker, Parker, Brody, and Schoenberg (1982) conducted multiple regression analyses on two samples of social drinkers using SILS Abstraction score as the dependent variable and age, QPO, SILS Vocabulary score, frequency of consumption, and education as the independent variables. They performed their first analysis on the sample tested by Parker and Noble (1977), entering each variable into the equation so that the effects of all other variables were held constant. As the authors expected, both age and QPO had significant, negative unstandardized regression coefficients (-.20 and -1.57 respectively) indicating that Abstraction performance decreased as age and QPO increased. They then applied the same regression modal to data from a sample of Detroit men tested in 1978 (reported in Parker, Kaelber, Harford, and Brody, 1983). Again, age and QPO were significantly and negatively related to Abstraction score. Thus, in two widely different samples using an appropriately sensitive method of analysis, QPO was demonstrated to be related to poorer abstractive functioning and increased age. Unfortunately, this study falls prey to the criticism that

there were no controls for the acute effects of alcohol consumption and no clear and effective way to screen out alcoholics.

In order to properly consider the results of the Detroit sample presented in Parker et al (1982) it is necessary to consider the multiple regression analysis presented in Parker, Parker, Brody, and Schoenberg (1983), and the original data collection procedure (reported in Parker, Kaelber, Harford, & Brody, 1983). The data were collected in metropolitan Detroit using a random sampling procedure.

Parker, Parker, Brody and Schoenberg (1983) conducted separate regression analyses for males and for those females who drank once a week or more (n=213) in the Detroit sample. This subsample of women was chosen because it more closely resembled the consumption pattern of the males in the sample. In both the male and female analyses QPO was significantly and negatively related to abstraction performance. Age also provided a significant and negative regression coefficient, while Vocabulary score was significantly and positively associated with Abstraction score.

It is apparent from the sampling procedure that the two regression studies utilizing the Detroit sample did not screen out individuals who were found to be alcohol dependent or problem drinkers. Thus, the significant and negative regression coefficient for QPO reported in both studies might more accurately have been reflecting the relationship between

alcohol dependence and QPO. Parker, Parker, Brody and Schoenberg (1983) were apparently aware of this potential problem and attempted to address it by adding the quadratic term of QPO to the regression models. In neither the male nor female sample was the quadratic QPO found to be significant. Similarly, controlling for alcohol consumption within the previous 24 hours, for lifetime consumption, for psychoactive medication use, and for body weight did not significantly alter the association between QPO and abstraction performance. The results presented in their study were particularly important because this was the first evidence to link decrements in cognitive functioning to alcohol consumption in a linear, dose-response relationship. In other words, it confirmed the Continuum Theory by showing that abstraction performance was related to increased QPO in social drinkers, problem drinkers, and dependent drinkers.

Hannon, Day, Buttler, Larson, and Casey (1983) set out to extend the work of previous researchers in the field by viewing the sober effects of social drinking in male and female college students. These were the first researchers to include a measure of current stress levels and they employed measures of cognitive functioning that had not previously been utilized in this line of research. Specifically, they were the first to use the Trail Making Test (Trails) and the Tactual Performance Test (TPT) from the Halstead-Reitan battery. The inclusion of such tests, as well as MacVane's

et al (1982) use of the Digit Symbol, reflects an apparent desire on their parts to link social drinking to sober psychomotor and perceptual-motor functioning. The other cognitive tests employed by Hannon et al (1983) included the SILS, WCST, and the Digit Symbol subtest from the WAIS.

Briefly, Hannon et al (1983) tested 52 female and 40 male undergraduate students. Aside from the cognitive tests mentioned above, participants provided information about alcohol consumption. As well, information for dividing the sample into groups of light, moderate, and heavy drinkers was collected.

Analysis of the consumption measures revealed no significant differences, save one, between males and females. The one difference that was revealed showed that significantly more males than females fell into the heavy drinking category. They concluded that the importance of this finding was negligible given that the more sensitive measures showed no sex differences. No significant sex differences were found on any of the cognitive measures.

Hannon et al (1983) found no significant correlations between stress and the consumption variables, and no significant correlations between stress rating and cognitive functioning in the female sample. However, four moderate, reportedly significant, negative correlations were found in the male sample.

So as to be comparable to the earlier studies, Hannon et al (1983) conducted a series of partial correlation analyses on the male and female samples. The first was an age- and education-partialled correlation analysis between the three consumption variables and 11 measures of cognitive functioning. Their second was a partial correlation analysis between the same variables while controlling for age, education, and the two consumption variables not under consideration at the time.

Again, it should be noted that claiming statistical significance for a few correlations without considering the effects of multiple comparisons can lead to inappropriate conclusions. There is no indication that Hannon et al (1983) took the effects of multiple comparisons into consideration when they conducted their analyses.

Both sets of analyses provided results which were quite inconsistent with most of the results from earlier studies. Viewed from the most sympathetic perspective, the results suggest a very complex relationship between alcohol consumption and cognitive functioning.

Hannon et al (1983) noted that QPO and measures of cognitive functioning were related in the predicted direction in the female sample, but for the male sample the relationship was not so clear cut. They also suggested that females may be more sensitive to the neuropsychological impact of social drinking. This was based on their finding

that the percentage of variance in cognitive functioning accounted for by drinking in the female sample was greater than that in the male sample. As a result, they recommended that future studies perform separate analyses on their male and female samples.

Although some might have concluded otherwise given the variable results which they presented, Hannon et al (1983) concluded that their results were consistent with previous findings. In their words, "Overall, the results of the present study support previous findings of decreased cognitive performance associated with both increased quantity of alcohol consumed per occasion and lifetime consumption..." (Hannon et al, 1983, p. 296).

A finding that is particularly worthy of note is that the two new measures included in this study provided no evidence to suggest that sober cognitive decrements are associated with social drinking. The importance of this finding lies in the fact that an attempt to link variations in psychomotor and perceptual-motor functioning to social drinking had been unsuccessful. Any evidence of decrements was still limited to the realm of abstract functioning.

A fourth study (Birnbaum, Taylor & Parker, 1983) viewing the relationship between cognitive functioning and social drinking was unique in two ways. First, and most importantly, it was designed to test a causal hypothesis. Second, it included a measure of mood in an effort to

determine what effects, if any, drinking patterns would have on this variable.

Birnbaum et al (1983) utilized a sample of 93 paid, female volunteers in a procedure which took place in three parts. In part one participants completed a mood inventory, a battery of cognitive tests, and a questionnaire which provided two measures of alcohol consumption: QPD and frequency.

In part two the authors requested all participants who drank at least three drinks per occasion to allow themselves to be assigned to one of two experimental conditions: An 'abstain from drinking' condition or a 'maintain usual drinking' condition.

Part three consisted of a second test session. In this second session participants completed the same tasks and provided measures of QPD and frequency of consumption for the period between the testing sessions.

Birnbaum et al (1983) conducted separate analyses on the data collected during the two testing sessions. They found that increased frequency was not significantly related to decreased cognitive functioning, nor with mood, so they eliminated frequency from further analysis and consideration. They ran a series of multiple regressions with QPD, age, and education as independent variables and with each of the cognitive and mood measures as separate dependent variables. In three of the 12 regression equations QPD produced

significant, unstandardized regression coefficients. Based on these regression coefficients, and on the low QPO reported in this female sample, Birnbaum et al (1983) noted that there was a limited relationship between drinking and sober cognitive performance.

The above conclusion is a rather open minded interpretation of the results. The only cognitive measure that QPO was reported to be significantly and negatively related to was Digit Symbol performance, and in that equation age accounted for more variance than QPO. No matter how these results are viewed, there is simply no evidence to support the contention that QPO is related to decrements in sober cognitive functioning.

Analyses were also conducted on the data obtained at the second test session. A series of two-way ANOVA's (group X session) were conducted using each of the cognitive and mood measures as dependent variables. No significant effects were found for any of the cognitive measures. Two of the mood measures yielded significant group by session interactions and, in the 'maintain' group, depression scores were found to be significantly higher in session two than in session one. Birnbaum et al (1983) concluded that higher levels of alcohol consumption produced increased feelings of depression, anger, and confusion in sober females.

Although the authors focussed most of their attention on the results which indicated a causal link between social

drinking and sober mood, the results from the cognitive tests are perhaps more interesting. Their's was the first study which attempted to demonstrate the reversibility of sober decrements when alcohol consumption was reduced, and it failed. There are only two possibilities which could explain such a finding: First, reversibility does not exist. Second, reversibility does occur, but for some reason Birnbaum et al (1983) missed finding any evidence of it. They chose the latter explanation and asserted that their sample did not drink enough to produce sober cognitive decrements.

One problem with accepting this explanation is that you must first accept the premise that there is a causal link between drinking and sober cognitive decrements. Once you have accepted that working premise, then no subsequent information can be used to disprove that premise. Their conclusion, that reversibility exists but went unnoticed in their sample, is dependent on faulty reasoning rather than evidence. There is another problem here as well. It is the logical problem of claiming that a lack of evidence (i.e. no reversibility of cognitive decrements) is supportive of the hypothesis (i.e. cognitive decrements are reversible when alcohol consumption is reduced) and not of the null hypothesis (i.e. that cognitive decrements are not reversible).

A slightly different approach to investigating the impact of social drinking resulted from the increased availability of Computerized Tomography (CT) scans. Cala and her colleagues have been working for 10 years on the anatomical and cognitive effects of various alcohol consumption levels. Based on her early results Cala has noted that brain atrophy, as measured by computerized tomography (CT) scan, varies as a function of alcohol consumption (Cala, Jones, Mastaglia, & Wiley, 1978; Cala, Thickbroom, Black, Collins, & Mastaglia, 1981; Cala & Mastaglia, 1981). Cala et al (1978) also reported that heavy social drinking was related to problems in sober 'abstract visuo-spatial' and 'visuo-motor' functioning. Unfortunately, Cala's conclusions about the impact of social drinking were based on a sample of drinkers who had been referred to a psychiatric facility because of concerns over their excessive alcohol consumption (Cala et al, 1978). Thus, such conclusions are unlikely to be generalizable.

Another series of studies presented by Cala and her co-workers examined the effect of abstinence on cerebral atrophy and cognitive functioning in social drinkers. Their first study (Cala, Jones, Burns, Davis, Stenhouse, & Mastaglia, 1983) presented results from initial testing and first follow-up testing. Subsequent studies (Cala, 1982; Cala, Burns, Davis, Jones, & Stenhouse, 1984; Cala, 1985) provided reports on later follow-up testing. On the basis of all this

work Cala (1985) concluded that alcohol consumption in social drinkers produces cerebral atrophy and cognitive decrements. As well, she asserted that such cognitive decrements and cerebral atrophy were reversible with abstinence and that a threshold of 40 grams of alcohol per day was necessary for tissue damage to occur.

The claims based on this research are entirely consistent with the Continuum Theory. Unfortunately, there is little reason to place any faith in the validity of their results or conclusions. The problems with this research range from sample selection bias and inconsistent testing procedures to inappropriate analysis and unclear reporting.

One of the major differences between Cala's work and that of North American researchers is the lack of any attempt on Cala's part to identify a variety of consumption variables. The subtle cognitive decrements reported by Parker and her various co-workers seem only to have been related to equally subtle measures of alcohol consumption. In contrast, Cala, using a crude measure of alcohol consumption and equally crude measures of cognitive functioning, has reported that social drinkers who become abstinent will significantly improve their overall intellectual functioning within six months. No other researchers have found such clear evidence of a causal, dose-response relationship between social drinking and cognitive

deficits. Conclusions based on Cala's evidence alone should be held in abeyance.

A better example of an attempt to provide convergent evidence using CT scans is Bergman's (1985) work. In his research with alcoholics Bergman had collected data from a large, randomly selected control group. It was this control group that made up the sample under investigation when he examined the relationship between social drinking, cognitive functioning and morphological cerebral changes (Bergman, 1985). Participants were tested with the Halstead-Reitan battery, two tests of memory, and tests of general intelligence. Participants also received a CT scan from which three measures of morphological cerebral status were taken. As well, four drinking variables were derived from a questionnaire and check-up interview. He reported results from those tests which had discriminated alcoholic patients from controls. One hundred ninety-five males and 192 females underwent the psychological testing while 193 males and 188 females received CT scans.

A series of partial correlations were conducted on both the total sample and a subsample of 'excessive' social drinkers. Results indicated that the amount of alcohol consumed in the 24 hours prior to testing was a better predictor of cognitive decrements than was maximum BPO. When the effect of recent drinking was statistically controlled, little evidence remained to support the contention that

social drinking was related to decrements in sober cognitive functioning. Based on this, Bergman (1985) noted that his results disagreed with the American studies and concluded that relatively high levels of QPO in social drinkers are not related to cognitive deficits nor to morphological cerebral changes.

Bergman (1985) asserted that by using a measure of the 'maximum' QPO rather than mean QPO he minimized the tendency to underreport consumption while still employing a measure that was comparable to what other researchers had utilized. He based this claim on MacVane's et al (1982) finding that maximum and mean QPO were highly correlated. However, there is some difficulty with this.

MacVane et al (1982) did not provide a mean QPO measure of consumption as Bergman (1985) maintained. Rather, MacVane et al (1982) measured 'Current Modal QPO' and 'Current Maximum QPO' and found a significant (.84) correlation between them. This is very interesting in light of Bergman's (1985) claim because, in spite of this finding, most of the significant correlations with cognitive functioning that MacVane et al (1982) found were for modal QPO and not for maximum QPO. The only significant correlation that they found between maximum QPO and cognitive performance was in the 'heavy social drinking' group and included a cognitive measure that Bergman (1985) did not use.

Bergman (1985) also claimed that the tests which best discriminated alcoholics from non-alcoholics in his other research "... ought not to be less sensitive for the detection of the potentially detrimental cerebral effects of social drinking than those used in the American studies." (p. 274). In other words, what is useful in detecting relatively gross cerebral dysfunction is equally useful in detecting more subtle cognitive decrements. This is simply not valid. Bergman (1985) chose a set of cognitive tests which had, at least in part, been used and found uninformative in earlier research (e.g. MacVane et al, 1982; Hannon et al, 1983). Yet, on the basis of these same measures he concluded that his results were contrary to the North American research. More accurately, what Bergman (1985) found was consistent with the North American studies which used the same cognitive tests.

In the same collection of papers, Parker, Parker, and Brody (1985) presented a reanalysis of the data originally presented in Parker, Parker, Brody and Schoenberg (1983). In it they addressed the hypothesis that certain individuals are genetically predisposed to cognitive decrements which, in turn, might lead to heavier drinking. Although they could not address this in any exhaustive manner, they did have participants' ratings of their father's drinking style and could include this in the multiple regression equation. They found that the regression coefficient for father's drinking

was non-significant for both males and females, and when this variable, as well as all other predictors, was controlled, the predictive power of QPO was not changed significantly.

Given that Parker and her colleagues held the view that the negative relationship between social drinking and sober cognitive performance had been firmly established, this was an appropriate endeavour. However, not all researchers in this area agreed that the evidence supported the existence of such a relationship. The paper by Hannon, Butler, Day, Khan, Quitoriano, Butler, and Meredith (1985) reflected this latter view.

Hannon et al (1985) presented three studies. The first has been reviewed above (Hannon et al 1983) and so the focus here will be on the latter two studies.

The second study presented by Hannon et al (1985) was intended to replicate the first (Hannon et al, 1983) using a sample of 103 female and 67 male college students. Separate correlation analyses were conducted for the males and females with the effects of age, class, and the consumption variables not under consideration being partialled out. They reported that lifetime consumption was significantly related to cognitive performance, in the predicted direction, for both males and females, and also noted that these were similar to the findings of their first study. However, while the tendency may have been similar, no significant correlation found in the first study was found in the second study.

The third reported study in Hannon et al (1985) utilized the same sample as the second study and attempted to demonstrate the reversibility of cognitive decrements associated with social drinking. Following the completion of the cognitive testing, all participants were assigned to one of two groups: a 'maintain drinking' group and an 'abstain from drinking' group. Two weeks after the initial testing participants were re-tested.

Because some of the 'abstainers' drank and some of the 'maintainers' did not, Hannon et al (1985) conducted their analyses on those who actually had abstained (n=83) and those who's alcohol consumption per kilogram of body weight was at or above the mean (n=51). When all cognitive variables were simultaneously considered, a discriminant function analysis was unable to correctly classify group membership at greater than chance levels. They concluded that no change in cognitive functioning occurred as a function of changes in drinking pattern. Their overall conclusion, after considering all three studies, was conditional; if there is a negative relationship between social drinking and cognitive functioning, it is variable, relatively weak and unless a suitable methodology can be developed to address this, then general agreement in this area will not be forthcoming.

Hannon's et al (1985) findings provided very little support for the contention that social drinking is associated with decrements in cognitive performance and no support for a

causal relationship between the two. One possible reason for this was that they conducted a reversibility study but designed it in such a way that a sensitive indicator of change over time could not be used. That is, they did not conduct a within groups analysis. Had they utilized tests with alternate forms or tests which are resistant to practice effects then they could have been better able to assess subtle changes over time.

It is apparent that until 1985 the research in this area had not convincingly demonstrated a causal relationship between social drinking and decrements in cognitive functioning. The results had been mixed and only suggestive of some undiscovered relationship. Despite this, Parker (1985) carefully put forward a more optimistic conclusion: "There is, however, sufficient evidence at this point to conclude that certain patterns of social drinking may interfere with (sober) mental efficiency." (p. 205).

Authors of the most recent research have concluded that their results do not support Parker's position. Like earlier researchers, Carey and Maisto (1987) attempted to evaluate the impact of social drinking on sober cognitive performance through the use of a reversibility study. Eighty-four female participants, 25 of whom drank no alcohol, agreed to participate in their study. All of the drinkers in the sample agreed to abstain from alcohol for three weeks and so

were randomly assigned to either an abstain or maintain drinking group.

Baseline analysis of the data consisted of a between groups comparison of the drinking and performance measures and an age and education partialled correlation analysis between the same. As would be expected, the total abstainers were significantly different on all measures of alcohol consumption than the drinkers. Only one difference was found on baseline cognitive performance; the total abstainers scored lower than the drinkers on the SILS Vocabulary score. The correlation analysis produced a pattern of results similar to what would be expected by chance. Separate 3 (groups) X 2 (sessions) ANOVA's with repeated measures were conducted for each test. Except for SILS Vocabulary, all groups did better on all cognitive tests at the second session. There was a significant group by session interaction on the SILS Abstraction score. That is, participants who did not drink improved over time while those who did drink did not improve. This is perhaps the most striking result because it reflects a differential effect of drinking on performance. However, as Carey and Maisto (1987) pointed out, it was possible (and in their opinion plausible) that the lack of improvement in the drinking group represented a ceiling effect rather than the disruptive effects of alcohol.

Carey and Maisto (1987) concluded that the reliability of results linking sober cognitive decrements to social drinking needs to be questioned. They noted that samples employed in this area of study often vary on a number of important demographic variables and as such may account for some of the disparate findings. The point they emphasized most, though, was that the relationship between cognitive functioning and social drinking is not as straightforward as originally thought. Including a variety of as yet undiscovered variables might be necessary in order to accurately describe and predict this relationship.

To sum up the above review, early correlational studies (e.g. Parker & Noble, 1977; Parker & Noble, 1980) reported evidence suggesting that QPO was negatively related to sober cognitive performance. Attempts to confirm these findings, however, could only provide conditional support (e.g. MacVane et al, 1982; Parsons & Fabian, 1982). In an effort to provide more convincing evidence, researchers tried to correct some methodological confounds and improve their statistical analyses (e.g. Parker et al, 1982; Parker et al, 1983). Unfortunately, convincing results were still not forthcoming so a different methodological approach was adopted by some researchers (e.g. Birnbaum et al, 1983; Hannon et al, 1985). These quasi-experimental, reversibility studies provided no support for the contention that social drinking produces sober cognitive decrements, although they

still provided some correlative evidence similar to the earlier studies. The most recent research (Carey & Maisto, 1987) took the same approach and, not surprisingly, did not provide any convincing evidence of the hypothesized relationship. At the present time then, studies in this area have not gone beyond attempts at demonstrating the existence of the hypothesized relationship.

It appears that after 10 years of research the safest overall conclusion is that in some circumstances, which are yet to be clearly identified, some styles of social drinking might be related to poorer performance in some aspects of cognitive functioning. This is an unsatisfying conclusion, but it is consistent with the results reviewed above. However, simply providing conclusions which are consistent with observed results does not help advance knowledge in the area. It is worth noting that the Continuum Theory, regardless of its current status, provided the initial impetus for contemporary studies into the effects of social drinking on sober cognitive functioning. Once the social drinking studies began, however, their results were intriguing enough to motivate further investigation independent of their connection to the Continuum Theory. Thus, the rationale for the social drinking research no longer lay in its ability to test a general theory, but rather in its ability to provide new and relevant information about the relationship in question. Unfortunately, that

strategy has provided no theoretical structure into which research results can be integrated. Such a theoretical structure is essential if new hypotheses are to be generated and new studies designed. The practical result is that little useful research has been conducted in this area for quite some time.

Parker has attempted to remedy this by discussing the implications of her research results. She has asserted that the consumption of relatively small doses of alcohol causes transient alterations in neuropsychological functioning which, after a period of non-exposure to alcohol, returns to 'normal' functioning (Parker, 1982; Parker & Parker, 1982; Parker et al, 1985). The only problem with her position is that it cannot account for the wide variation in findings from other studies. Only one other endeavour has attempted to present a theoretical rationale, or explanation, for what has been found: Hill and Ryan (1985).

Hill and Ryan (1985) began by recognizing that there was no convincing evidence to indicate that social drinking produced permanent brain damage. They then considered the implications of this finding for the Continuum Theory and concluded that although a biological continuum of impairment was unsupported, a behavioral continuum of impairment might exist. They were also aware that the results linking cognitive performance decrements to social drinking were inconsistent and weak. Having identified these separate bits

of information they set about trying to develop a theoretical framework which could both link and explain them. To this end, they proposed that alcoholics and social drinkers experience separate processes which produce effects in neuropsychological performance. For the alcoholics they suggested that this effect results from brain tissue damage, which is consistent with neurological and neuropathological evidence. For the social drinkers they suggested that small observed changes in neuropsychological functioning might reflect a transient phenomenon during which normal neuropsychological functioning is disrupted.

To reiterate, Hill's and Ryan's (1985) model posits the existence of two separate processes which produce disruptions in cognitive functioning. Below some threshold of consumption, alcohol produces transient, dose dependent disruptions in some aspects of sober cognitive functioning. Above that threshold tissue damage occurs, which is also expressed in disruptions of sober cognitive functioning, but which are more extreme and long lasting. Some implications of this model are the following: The most likely occurrence of sober decrements in social drinkers will be found in those who are closest to the above mentioned threshold. However, such an expectation ignores the influence of tolerance (e.g. Poulos, Wolf, Zilm, Kaplan, & Cappell, 1981; Mann & Vogel-Sprott, 1981; Mann, Vogel-Sprott, & Genest, 1983). The linear dose-response effect of social drinking must be

modified by the presence of tolerance. In other words, to produce the same level of cognitive decrement in two social drinkers, one of whom has developed some tolerance, different amounts of alcohol must be ingested. A further implication, therefore, is that no consistent, absolute amount of alcohol will produce minimal decrements in all individuals.

In terms of earlier research on the effects of social drinking, Hill and Ryan (1985) noted that the studies which included participants with lowest tolerance (as measured by total lifetime consumption levels) should have produced the greatest correlations between BPO and cognitive performance. They conducted what they called and 'quasi-meta-analysis' on the research prior to 1985 and found that this was indeed the case.

This theorizing by Hill and Ryan (1985) provides considerable assistance when considering the reversibility studies (Birnbaum et al, 1983; Hannon et al, 1985; Carey & Maisto, 1987). Put simply, reversibility studies cannot provide evidence of cognitive decrements because tolerance effects confound the results. That is, participants' usual consumption produces the same effect as not drinking at all. Thus, reducing consumption to zero produces no change in sober cognitive functioning. Similarly, such a tolerance effect confounds the results of correlational studies, leaving neither of these designs as particularly useful.

Further efforts similar to the majority of studies in this area will not be worthwhile.

However, the question of whether or not there is a causal link between social drinking and sober cognitive decrements remains unanswered, so there is obviously a need for further research. This future research must be based on some firm theoretical ground and it seems that, to this point, Hill's and Ryan's (1985) is the best.

The most effective means of addressing the relationship between social drinking and sober cognitive functioning would be to conduct a study in which exposure to alcohol is experimentally manipulated. In terms of the variables to be examined in such a study, the best research in the area (Parker et al, 1982; Parker et al, 1983) indicated that the critical drinking variable was QPO and that it's negative effect was most apparent in abstract functioning. In particular, QPO was found to be negatively associated with the Abstraction score from the SILS. Thus, abstract functioning seems the most appropriate cognitive variable to view in order to test the hypothesized relationship.

It is with such considerations in mind that I propose to investigate the relationship between social drinking and sober cognitive functioning. Through the experimental manipulation of alcohol exposure this study will determine if there is a causal relationship between social drinking and sober functioning. Specifically, the study will test the

hypothesis that increased QPO produces decrements in sober cognitive functioning. A between groups comparison of those who do receive alcohol and those who do not, as well as a within groups comparison of individuals who receive both their usual number of drinks and an increase over their usual consumption, will test this hypothesis.

CHAPTER II

Method

Participants

Participants for the present study were drawn from the undergraduate population at the University of Windsor and were restricted to students enrolled in the Introductory Psychology course offered through the Psychology Department. Participation in the study was limited to those who met the following criteria: non-abstainers; 19 years of age or older; no history of neurological disorder; no hazardous patterns of alcohol or other drug use, current or past.

Employing such a sample has a number of advantages. First, because such individuals are generally young adults, the elapsed time during which tolerance to alcohol could be developed is minimized. In this way the potential confounding effects of tolerance were minimized. Second, such students are in a situation where their cognitive functioning is an essential component of success. Any decrements in such functioning could have important implications for that success and because of this, examining the hypothesis in this population seems immediately relevant. Third, the findings of a recent survey indicate that increased consumption at a sitting (i.e. higher QPO) is more likely among younger adults and those with post-secondary education (Addiction Research Foundation's Ontario Report, Vol. 1, no. 2, Sept. 1987). Thus, using this sample of

university students maximizes the likelihood of addressing the hypothesis while ensuring that the results have some validity outside the laboratory setting.

The decision to include only non-abstaining participants was based on ethical considerations. Put simply, if an individual has no experience with alcohol, a potentially harmful drug, then a choice to begin drinking should be made for personal reasons. Participation in a research project should not be a relevant factor in making such a choice, so abstainers were not allowed to participate.

The reason for excluding potential participants if they were under 19 years of age is legal in nature. As this study was intended to examine the effects of a legally controlled substance, the experimenter was required to adhere to the applicable laws and regulations. Thus, participation had to be limited to those 19 years of age or older.

The purpose of the screening procedure was to eliminate the interference of as many confounding factors as possible. Given that the hypothesis asserts the existence of a change in cognitive functioning, it is appropriate to screen out individuals whose cognitive performance might be influenced by other pre-existing factors. The impact of such factors was minimized by excluding individuals whose performance might reasonably have been expected to vary as a function of such confounding variables (e.g. history of neurological disorder, history of alcohol/drug abuse).

Initial contact with potential participants was made through in-class solicitation of volunteers. That is, the experimenter addressed various Introductory Psychology classes and requested the participation of students enrolled therein. The study was described as an attempt to investigate the relationship between alcohol consumption and sober cognitive functioning and the initial criteria for participation (non-abstaining individuals 19 years of age or older) were given. The experimenter and the course lecturer also explained the external incentive for participating in this or other research projects. That is, it was explained to the class that participation in ongoing research projects would give them course credits of up to three percent of their final grade. Students were assured that if they were disqualified for the present research, other projects would be forthcoming in which they could accumulate their maximum allowable course credits.

In an effort to minimize the intrusion on class time, volunteers were asked to attend a second meeting where the study, and their role in it, was explained in greater detail. Those interested in participating were also asked to list their name and phone number on a sign-up sheet.

Approximately 120 volunteers attended the second meeting. The experimental nature of the study was explained at that time and participants' possible role in it (i.e. exposure/non-exposure to alcohol) was outlined. Any

questions which these volunteers had were then answered, provided that the hypothesis of the study was not revealed. Following this question period volunteers were asked to read and sign a consent form indicating their willingness to participate and their understanding of the procedure (see Appendix C for a copy of this consent form). After filling in the consent form, a total of 105 volunteers agreed to complete the questionnaire and a one month drinking history (see Measures section below). At the completion of this task the volunteers were reminded that should they be selected to continue in the study they would be contacted by phone.

Following this session, and using some of the results from it, participants were screened. Those whose questionnaire responses indicated a history of drug abuse or possible neurological problems (e.g. head injury resulting in unconsciousness) were screened out of the study at this time. Others were screened out because they were currently under a physician's care and were taking prescribed medications. Still others screened out because their calculated mean QPD was greater than eight standard drinks. All volunteers who were not screened out were then contacted by phone. During this phone call the volunteers were asked to continue in the study, and if they agreed, were informed of their group assignment. To minimize the loss of potential participants, those volunteers who indicated that they would be unable to participate in the study because of group

assignment (i.e. conflicts with work schedules or difficulties in attending Saturday evening sessions) were offered the other group. In this way the number of potential participants was maximized, although at the cost of an unequal gender distribution between groups. It is worth remembering that participants in this study were being asked to commit themselves to procedures which made heavy demands on their time. Participation in the control group required a five to six hour committment across eight weeks, while the alcohol group required a 26 hour direct time committment from its members over eight weeks. Also during this telephone call, participants assigned to the experimental group were asked to provide a medical consent form (see Appendix C). Finally, they were told the time and place of their next meeting with the experimenter.

Only 48 of the 105 volunteers met with all the inclusion criteria and agreed to participate further in the study. Twenty-six of these were assigned to the experimental group with the remaining 22 assigned to the control group. Further attrition over the eight week course of the study, and elimination of data from participants who did not comply with study requirements, resulted in a final sample size of 36, 18 in each group.

Measures

a) Measures of cognitive functioning (see Appendix B for copies of all measures);

1) Shipley Institute of Living Scale (SILS). This is a frequently used assessment device for the investigation of sober cognitive functioning in both alcoholics and social drinkers. It measures general intellectual functioning and provides Vocabulary, Abstraction, and Conceptual Quotient scores, as well as a WAIS-R IQ estimate. An alternate form of the SILS was developed and employed as well.

2) Employee Aptitude Survey (EAS) (Grimsley, Ruch, Warren, & Ford, [1986]; Ruch & Ford, [1986]). Selected subtests of the EAS (Verbal Reasoning and Symbolic Reasoning) were administered which allowed for the evaluation of verbal and non-verbal reasoning performance. The EAS has been validated on various university student populations. While one alternate form was available for the Symbolic Reasoning subtest, the study's design necessitated the development of two other alternate forms for this subtest and three alternate forms for the Verbal Reasoning subtest.

b) Other Measures (see Appendix B);

1) A questionnaire designed to elicit information from participants concerning their health, drinking patterns, and demographics (i.e. age, body weight, socio-economic level).

2) State Trait Anxiety Inventory (Spielberger, Gorsuch, & Lushane, 1970), State Anxiety Scale (SAS). This measure assesses the current level of anxiety an individual is experiencing.

3) A self-report, calender-cued drinking history (CCDH). This procedure provided a measure of alcohol consumption for the four week period prior to the first meeting. Alcohol consumption was reported in standard drinks consumed as defined on the CCDH itself. Measures of the mean Quantity Consumed per Occasion (QPO), Frequency of Consumption, and Total Consumption were derived for each participant.

4) A brief, self-report of alcohol consumption in the previous 72 hours. Again, consumption was reported in standard drinks as defined for the participants on the device.

Procedure

The present study included both between and within subjects design components. The between subjects component included two groups, one of which received no alcohol at all (control group) and the other which did receive alcohol (alcohol group). The within subjects component consisted of exposing all alcohol group participants to three different levels of alcohol consumption. In the first condition each participant had access to no alcohol. In the second condition each participant had access to his or her usual number of drinks (i.e. his or her QPO). In the third condition each participant was allowed access to a one third increase over his or her usual alcohol consumption (i.e. QPO + [QPO/3]).

The study also attempted to temporally counterbalance exposure to alcohol. That is, at the first session no alcohol was available to participants (condition 1). At session two, all participants in the alcohol group were allowed access to alcohol. However, only half of this group was allowed their mean consumption level (condition 2) while the other half was allowed a relative increase over their usual consumption (condition 3). At session three, participants again had no access to alcohol (condition 1). At session four, those participants who had, at the previous session, consumed more than their usual number of drinks were limited to an amount equal to their QPO (condition 2). Those who drank at their QPO or below at session two were allowed access to the 33% increase over their QPO at session four (condition 3). All participants were asked to refrain from drinking any alcohol in the 24 hours prior to each of these experimental sessions. Figure 1 presents a graphic representation of this procedure.

It is worth noting that in condition three, participants received an equivalent increase in allowable alcohol regardless of their usual, individual drinking practices. In this way the influence of a relative increase, rather than an absolute increase, can be viewed.

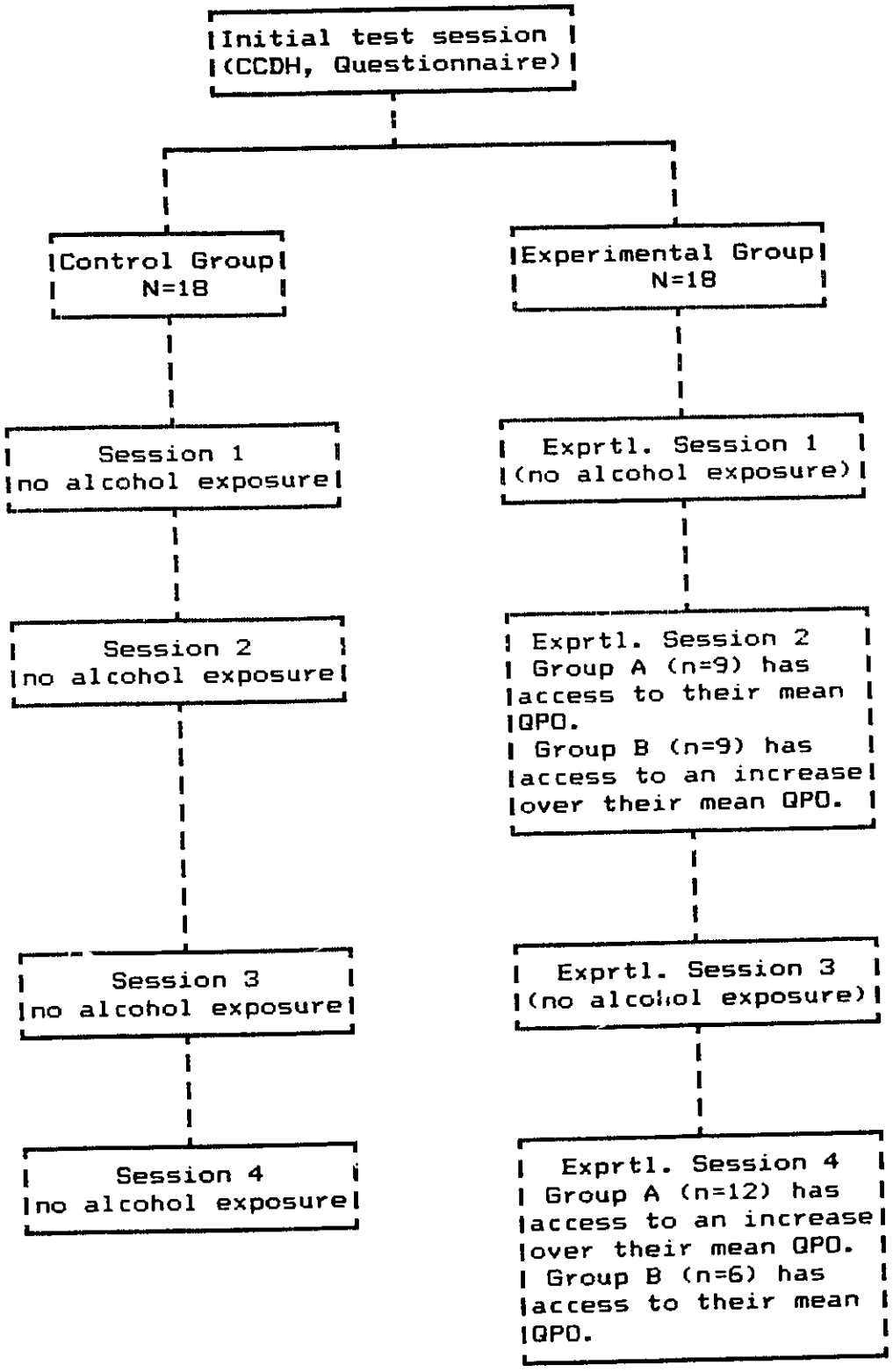
An arbitrary ceiling was set on the amount of alcohol that any participant could consume. That is, no participant was allowed to consume more alcohol than his or her reported

maximum consumption in the previous six months. As well, no participant, regardless of his or her maximum consumption, was allowed to consume more than eight standard drinks at a single session.

Experimental manipulation. As indicated earlier, the experimental group was to receive access to varying amounts of alcohol, but to do this required that a suitable location, with the appropriate licenses, be found. The University of Windsor Graduate Student Society's Grad House was chosen as the site for all sessions where alcohol was to be consumed. This setting had the advantage of being on campus and so was easily found by participants in residence as well as those living off-campus. It also provided a unique environment where the normal atmosphere of a university pub could be maintained while the quirks of conducting behavioral research could be accepted. Finally, because of the researcher's status as a graduate student, the facilities could be used without the necessity of paying a rental fee.

The entire second floor of the Grad House was set aside for the exclusive use of the study and in this way participants were isolated from other patrons. Three rooms and a separate washroom were at the disposal of the study and these were separated from the rest of the pub by a single door to the connecting stairway. On the evenings when the study was being run, a sign was hung on this door denying access to everyone save those connected with the study.

Figure 1: Graphic representation of study procedure.



On a bi-weekly basis over the course of eight weeks the alcohol group participants gathered on Saturday evening at the Grad House. Each such gathering reflected a different session and hence a different experimental condition (see Figure 1).

Prior to each gathering, participants' maximum allowable level of alcohol consumption was calculated. Upon arrival at the experimental site every participant received a card with two numbers printed on it. One of these numbers indicated the maximum number of standard drinks allowed, while the other was the participant's assigned identification number. As the identification number was always four digits and the maximum allowable drinks always one digit, there was no difficulty with confusing the two numbers on the card.

Upon entering the setting the participant's first action was to 'register' with the support volunteers. The registration procedure consisted of checking the participant's name against a list for the correct participant number, having the participant read over and sign a consent/agreement form for the evening (see Appendix C), and finally giving the participant his or her own card with the above mentioned numbers on it. At that point the participant was free to enjoy the remainder of the evening, provided that he or she remained at the study site and complied with the conditions set out in the signed agreement.

In order to receive an alcoholic drink in those sessions where it was allowed, a participant was required to show his or her card to a volunteer assistant. If the number of holes punched in the card was fewer than the number of drinks allowed, then the volunteer would take the participant's order for a drink. The volunteer would then go downstairs to the bar, where a tab was being run, get the drink from there, and return to the participant who had ordered it. The participant would then give his or her card to the volunteer who would put one hole in it with a hole-punch. When the number of holes was equal to the number of allowed drinks, the volunteer was to keep the card. In this way no participant could receive more alcohol than he or she was supposed to receive. In the event that a participant tried to order a drink after his or her maximum had been reached, the volunteer simply refused and pointed out that the limit had been reached. When the time limit on serving alcohol (12:00 midnight) expired, all the outstanding cards were collected, regardless of whether all participants had reached their respective maximum.

A number of activities were available to participants while at the experimental sessions. Various board and parlour games, decks of cards, and video tapes of movies were supplied. Snack food, soda pop, and coffee were also available free of charge.

The three rooms set aside for the study quickly became defined by the function which they served. That is, the room where participants left personal belongings and signed the consent/agreement form became the centre for administering the study and the room where the volunteer assistants and the experimenter mainly stayed. A second large room, with a television and video cassette recorder, became the main social interaction room for the study. In this room participants gathered at the beginning of the evening before breaking into smaller groups. Once this larger gathering split up, the back end of this room was dedicated to conversation, word games, or card games. The front of this room, because of the T.V. and V.C.R., became the theatre. Participants in this area spent the majority of their time watching the movies which were supplied. The third, and smallest, room became dedicated to a board game. This game, Risk, can include up to seven players and at each session the maximum number of players was included.

Ethical Considerations. Given the nature of the study a number of safeguards were developed so as to ensure the safety of the participants. First, in order to maintain as much influence over participants' actions during the evening as possible, a separate consent and waiver of responsibility was completed at the start of each experimental session (see Appendix C). This form committed participants to remain in the session until a study volunteer could accompany them to

their residence. The form also stipulated that if a participant was to leave the session without such an escort, the experimenter, the University, and all individuals and institutions assisting in the study could not be held responsible for any consequences befalling the participant. At the first experimental session (when no alcohol was available) one participant exercised his right to leave early indicating that he did not feel well. At session three a second participant withdrew from the study and was driven home. No other participants left a session early for the remainder of the study.

Second, participants were never allowed ad lib access to alcohol. They were deliberately isolated from the source of the alcohol so that the study volunteers could maintain control over the flow of alcohol. It is also important to note that in those conditions where participants could drink, their consumption was limited to a pre-determined number of standard drinks. This pre-set level never exceeded the already established maximum level of consumption reported by the participant. Also, this was only a ceiling on consumption and did not reflect a minimum consumption level. In those conditions where alcohol consumption was allowed, participants were free to consume any amount of alcohol less than the pre-determined cut-off level. At no time did any person working for the study attempt to 'push' drinks.

Another safeguard was the presence, at every experimental session, of non-participating, sober, graduate student volunteers. These volunteers acted as drink procurers and recorders, saw to it that all participants had signed the appropriate consent/agreement, and provided general supervision over the course of the evening. At no time were there fewer than three such volunteers, including the experimenter, at the experimental session. Perhaps the most important role that the volunteers fulfilled was ensuring that all participants arrived home safely. At the conclusion of each experimental session, these volunteers either drove or accompanied every participant to his or her residence.

Yet another safeguard for the study was the limitation placed on the availability of alcoholic drinks. That is, no alcoholic drinks were available past midnight. As well, participants were required to remain at the site until 1:00 a.m. which provided two benefits. First, the elapsed hour during which no alcohol was available diminished the acute impact of alcohol on participants' functioning. Second, by keeping participants on site until 'after hours', the chance of them drinking after the experimental exposure was minimized.

Testing Procedure. All participants, both alcohol and control, were tested on four different occasions using the cognitive tasks described earlier. Each group was tested

separately and all tests were administered in group settings. The entire testing procedure took approximately 45 minutes to complete. The order of test presentation was as follows: Testing session one; Self-report Measure of Alcohol consumption in the previous 72 hours, EAS Verbal Reasoning, SILS Abstraction, EAS Symbolic Reasoning, SILS Vocabulary, SAS. Testing session two; same as session one. Testing session three; Self-report Measure of Alcohol consumption in the previous 72 hours, SILS Vocabulary, EAS Symbolic Reasoning, SILS Abstraction, EAS Verbal Reasoning, SAS. Testing session four; same as three.

The reason for using the same order of test presentation in sessions one and two, and then a different order in sessions three and four, was to enhance the likelihood of uncovering a change in performance in the alcohol group. As the alcohol group received no alcohol prior to testing session one (baseline) and exposure to alcohol prior to testing session two, I wanted to ensure that these testing sessions were as comparable as possible. Similarly, session three served as a baseline for session four, but the order of test presentation was changed from the first two sessions so as to minimize any order effects. In all sessions the verbally mediated tests alternated with the non-verbally mediated tests.

At each testing session, participants received the materials in a brown manilla envelope. These envelopes were

opened and the testing materials removed at the direction of the experimenter. To ensure that the instructions for the tasks were understood by all, the experimenter read aloud the instructions for each test. Following the reading of the instructions the participants were asked if they had any questions regarding the task. If none were forthcoming then the experimenter gave the signal to begin the test and started timing it. The EAS subtests had a time limit of five minutes each and the SILS subtests had a time limit of 10 minutes each. Participants were allowed as much time as they wanted to complete the Self-report drinking measure and the SAS, but never took more than five minutes to complete either. At the conclusion of the session participants put all of the completed materials back in the envelope, wrote their participant number on the outside of the envelope, and handed it in to the experimenter.

Participants in both the control and alcohol groups were tested on a bi-weekly basis and were asked to remain abstinent prior to that session. The control group was tested on Friday afternoons while participants in the alcohol group were tested on Monday afternoons. Participants in the alcohol group were asked to remain abstinent for the period between the experimental sessions and the testing sessions (36 hours) and participants in the control group were asked to remain abstinent for 48 hours prior to the testing sessions.

Data Analysis. As noted in earlier, all participants were to complete a questionnaire and the CCDH prior to group assignment. Based on their responses to the questionnaire participants were either accepted into or screened out of the study. All analyses were performed on data from those participants who screened into and completed the study.

Data analysis began by comparing the two groups on their baseline consumption and cognitive functioning. As will be reported in the Results section, there was some indication of a potential confound in the data. Although not statistically significant when controlled for multiple comparisons, the two groups showed apparently different initial QPO levels (See Table 10, Appendix D). This might have resulted from the disproportionate gender assignment (i.e. more females in the Control group and a smaller QPO for the Control group) or perhaps from participants' self selection (i.e. those who drink more chose to remain in the Alcohol group while those who drink less refused and so were reassigned to the Control group). Any subsequent group differences might arguably be more attributable to such an a priori difference than to experimental effects. To ensure that this would not occur, QPO was included as a covariate in the data analysis and in this way the potential confound was controlled statistically.

A second covariate was also included in the analysis. Situational anxiety might also account for observed changes in performance scores. Thus, to control for the potentially

confounding effects of situational anxiety, SAS scores were included as a covariate in the data analysis.

In the Participants section above it was revealed that the ratio of males to females was different in the two groups. Unfortunately, the group assignment procedure failed to provide an equal distribution of gender. To control for this unequal distribution, gender was used as an independent, or grouping, variable in the analyses. Thus, gender, as well as group, was included as a two level, between subjects variable in the analysis design.

To summarize, while the design of this study was intended to control for as many extraneous and potentially confounding factors as possible, the reality of the situation was such that one important variable may have differed between the two groups; Gender. QPO, although not significantly different between groups, was also important enough so that observed variations were cause for concern. To assure the validity of the results then, these two variables needed to be controlled statistically. As well, the analysis needed to take into account the repeated exposures to cognitive tests and double baseline design. Hence, the analysis model included Group (control vs. alcohol) and Gender (female vs. male) between subjects components, as well as Set (testing sessions one and two vs. testing sessions three and four) and Time (testing sessions one and three [baseline] vs. testing sessions two and four

[exposure]) within subjects components, with mean QPO and anxiety at the time of testing as covariates. The principle analysis of the data, then, consisted of a 2 X 2 X 2 X 2 repeated measures multivariate analysis of covariance (MANCOVA).

Perhaps at this point it is worth repeating the hypothesis of the study. Specifically, the hypothesis asserted that increases in QPO, or dose level, will produce decrements in sober cognitive functioning. The present design addressed this in two ways. First, and implied in the hypothesis, it was important to determine if the consumption of alcohol had any impact at all on sober cognitive functioning. The between groups comparisons of those who received alcohol and those who did not allowed this effect to be assessed. Second, within subjects comparisons of individuals who received both their mean QPO and a 30% increase over their mean QPO allowed the explicit assertion, that increases beyond usual consumption levels produces sober decrements in cognitive functioning, to be tested. Results which reflect group differences in cognitive functioning at sessions two or four would be consistent with and supportive of the hypothesis. Similarly, for the experimental group significant decreases in performance from session one to session two or from session three to session four would also be supportive of the hypothesis. In terms of the analyses

conducted here, such an effect would be reflected in a significant Group by Time interaction.

The dependent variables for the first set of analyses consisted of the Vocabulary and Abstraction scores from the SILS, the total score from the EAS Verbal Reasoning subtest, and the total score from the EAS Symbolic Reasoning subtest. Four scores from each of these, one for each testing session, were included.

Conceptually, the MANCOVA procedure performed the analysis by combining performance on all the dependent measures and then viewing this performance from different perspectives. That is, in the first analysis MANCOVA calculated the best linear combination of dependent measures after statistically controlling for the identified covariates. Using this new 'combination variable' it then compared the control group to the experimental group, and male to female participants. The MANCOVA procedure also determined performance on this 'combination variable' for the Set and Time combinations described above. The MANCOVA program then compared each participant's performance on the session one/two Set with his or her performance on the session three/four Set. In this way the two 'sub-studies' which make up this research can be compared and any study-wide effects noted. In a sense, this is an examination of the self-replicating nature of the study. The MANCOVA also compared performance at the session one/three Time with

performance at the session two/four Time. In this way baseline performance was compared to experimental performance across both sub-studies. The MANCOVA procedure also assessed all of the above factors for interactions.

A second set of analyses were conducted focussing exclusively on the experimental group. These were intended to directly address the hypothesis that relatively small increases over usual consumption levels produces sober cognitive decrements. The same Group by Gender by Set by Time design was applicable and so the same MANCOVA model that was used for the total sample analysis was used in this analysis as well. However, because the alcohol group participants were allowed to drink less than their experimentally determined maximum, some of these participants did not increase their alcohol consumption beyond their mean QPO. Those who did not increase their alcohol consumption were dropped from this analysis. As well, the remaining females in the sample were dropped from this analysis. The Group factor in this design consisted of 1) participants who consumed more than their QPO at the second 'party' and 2) participants who consumed more than their QPO at the fourth 'party'. The Gender factor, because only males were included in the analysis, was dropped from this MANCOVA model.

All analyses were conducted using SPSS-X program Release 3.0 for VAX/VMS. These were the computing facilities available at the Addiction Research Foundation main office in Toronto where the analyses were conducted.

CHAPTER III

Results

Before presenting the main analyses of the study, a brief description of the sample characteristics and the test form reliabilities is given. The results of the study are then reported in the same order as was presented in the Data Analysis section above.

Sample Characteristics

Appendix D provides a tabular presentation of some relevant characteristics of the total sample and the two sub-groups. Descriptive information concerning demographic aspects of the sample as well as alcohol consumption measures and baseline cognitive functioning measures are presented there.

Demographics. As noted in the Methods section, the sample for this study consisted of 17 female and 19 male undergraduate students enrolled in an Introductory Psychology course. The mean age for the sample was 21.0 years (SD = 3.56) with a median socio-economic rating of social class III (Hollingshead Two-Factor Index of Social Class). The sample was equally divided into an experimental group (alcohol group, N=18) and a control group (N=18). The alcohol group had a mean age of 21.1 years (SD = 4.19) and a median Hollingshead Index rating of Social Class III while the control group had a mean age of 20.9 years (SD = 2.9), and also had a median Hollingshead Index rating of Social Class

III. The control group consisted of 12 females and six males while the alcohol group included five females and 13 males. This reflects a significant difference ($X^2(1, N = 36) = 4.01$, $p<.05$ after Yates correction) in the distribution of gender (see Table 8, Appendix D for a tabular presentation of sample characteristics).

Also as noted in the Methods section, volunteers who indicated that they would not participate in the study because of group assignment were offered the alternative group. This non-random assignment to groups was used to minimize the loss of potential participants and resulted in the unequal gender distribution. Such a difference in distribution leads to the possibility of a systematic gender confound, so a comparison of baseline measures by gender was performed. Males and females in the sample did not differ significantly on any consumption measure, on any baseline cognitive measure, nor on age. The only variable on which males and females were found to be significantly different was weight ($t(34)=-5.89$, $p<.0009$). See Table 9, Appendix D for a presentation of baseline measures by gender.

Questionnaire responses indicated that the control and alcohol groups did not differ on any of the issues polled. That is, no differences were found between the two groups on the Hollingshead Two Factor Index of Social Class, on drug use (either prescription, over-the-counter, or recreational), on current treatment for medical disorders (epilepsy, liver,

heart), nor on self-reports of symptoms consistent with neurological difficulty (seizures, memory loss, tremors, clumsiness, dizziness, severe headaches, fainting spells).

Alcohol Consumption. The questionnaire also provided three self-report measures of alcohol consumption: Maximum consumption in the past six months, frequency of days at maximum consumption levels, and usual number of drinks consumed. The two groups did not differ significantly on any of these alcohol consumption measures.

Three other alcohol consumption measures were obtained from the Calender Cued Drinking History (CCDH): A measure of the frequency of drinking (i.e. the number of days, out of the past 28, on which alcohol was consumed), the absolute number of standard drinks consumed in the past 28 days, and the mean quantity of alcohol consumed per drinking occasion (in standard drinks - QPO). On two of these consumption measures, and before correcting for multiple comparisons, group differences were observed. During the 28 days prior to initial testing, the total number of standard drinks consumed by the alcohol group ($\bar{X}$=34.22, Sd=21.18) was higher than the control group ($\bar{X}$=20.58, Sd=14.6; $t(34)=2.25$, $p<.05$). Because QPO was a calculated variable based in part on this same measure, the alcohol participants also had a higher QPO ($\bar{X}$=4.63, Sd=1.90) than did control participants ($\bar{X}$=3.17, Sd=1.46; $t(34) = 2.58$, $p<.05$). See Table 10, Appendix D for a tabular presentation of baseline alcohol consumption.

Before concluding that the groups were significantly different in baseline alcohol consumption (and hence reflective of an important confound to this study) two points should be made. First, when the impact of multiple comparisons was taken into consideration, neither of these measures retained their significance (employing the Bonferroni correction in this case requires that the *t* values meet a $p<.003$ criterion in order to be considered significant). That is, the alcohol and control groups were no different in their baseline alcohol consumption. Second, it is also worth noting that QPO was employed as a covariate in the data analysis. Although the groups did not differ, baseline consumption does vary among participants. Covarying the individual's QPO makes all participants statistically equivalent on baseline consumption and insures group equivalency.

Cognitive Functioning. Participants' initial levels of cognitive functioning were also considered, and a comparison (*t*-tests) of cognitive performance at testing Session 1 revealed no significant group differences. Thus, the assumption of essential equivalency in cognitive functioning between the groups was supported (see Table 11, Appendix D).

Alternate Form Reliability. The design of this study called for the repeated testing of cognitive functioning over four testing sessions. However, most available tests have no alternate forms. Those which do typically have only one

alternate form. For the present case, this situation had to be rectified by creating a number of new alternate forms and to establish their reliability. To do this, between form correlation coefficients were calculated.

The between forms correlation coefficients from the control sample were first considered as the most appropriate indication of reliability because control participants were not exposed to alcohol. Thus, their performance on the cognitive tasks was an 'uncontaminated' indication of the alternate forms' reliability. Table 1 presents the intercorrelations of test scores between alternate forms for the control group. When the alcohol group was also included, somewhat lower, but consistent correlations were found (see Table 2). Both the control group and the total sample correlations indicate considerable reliability between the alternate forms. All reported correlations, whether from the total sample or control group, are statistically significant.

Table 1

Correlations Between Alternate Test Forms:

Control Group (N=18)

	SILS Vocabulary Subtest			
	Original Time 1	Alternate Time 2	Original Time 3	Alternate Time 4
Original Time 1	1.00			
Alternate Time 2	.6328**	1.00		
Original Time 3	.8634***	.6401**	1.00	
Alternate Time 4	.7629***	.8219***	.7194***	1.00

	SILS Abstraction Subtest			
	Original Time 1	Alternate Time 2	Original Time 3	Alternate Time 4
Original Time 1	1.00			
Alternate Time 2	.5715**	1.00		
Original Time 3	.7379***	.4794*	1.00	
Alternate Time 4	.4848*	.5886**	.7072***	1.00

* significant correlation, $p \leq .05$, two-tailed
** significant correlation, $p \leq .01$, two-tailed
*** significant correlation, $p \leq .001$, two-tailed

(table continues)

Table 1 (continued)

Correlations Between Alternate Test Forms:

Control Group (N=18)

	EAS Verbal Reasoning			
	Time 1	Time 2	Time 3	Time 4
Time 1	1.00			
Time 2	.7148***	1.00		
Time 3	.7345***	.7293***	1.00	
Time 4	.6923***	.5620*	.6973***	1.00

	EAS Symbolic Reasoning			
	Time 1	Time 2	Time 3	Time 4
Time 1	1.00			
Time 2	.6086**	1.00		
Time 3	.7959***	.7072***	1.00	
Time 4	.8559***	.7640***	.8469***	1.00

* significant correlation, $p \leq .05$, two-tailed
** significant correlation, $p \leq .01$, two-tailed
*** significant correlation, $p \leq .001$, two-tailed

Table 2

Correlations Between Alternate Test Forms:

Total Sample (N=36)

	SILS Vocabulary Subtest			
	Original Time 1	Alternate Time 2	Original Time 3	Alternate Time 4
Original Time 1	1.00			
Alternate Time 2	.7055**	1.00		
Original Time 3	.8175**	.7193**	1.00	
Alternate Time 4	.7823**	.8179**	.7565**	1.00

	SILS Abstraction Subtest			
	Original Time 1	Alternate Time 2	Original Time 3	Alternate Time 4
Original Time 1	1.00			
Alternate Time 2	.6596**	1.00		
Original Time 3	.7908**	.7579**	1.00	
Alternate Time 4	.6503**	.8043**	.8392**	1.00

* significant correlation, $p \leq .01$, two-tailed
** significant correlation, $p \leq .001$, two-tailed

(table continues)

Table 2 (continued)

Correlations Between Alternate Test Forms:

Total Sample (N=36)

	EAS Verbal Reasoning			
	Time 1	Time 2	Time 3	Time 4
Time 1	1.00			
Time 2	.6377**	1.00		
Time 3	.6706**	.6464**	1.00	
Time 4	.5445**	.5929**	.5652**	1.00

	EAS Symbolic Reasoning			
	Time 1	Time 2	Time 3	Time 4
Time 1	1.00			
Time 2	.5936**	1.00		
Time 3	.7024**	.6771**	1.00	
Time 4	.6814**	.6530**	.7531**	1.00

* significant correlation, $p \leq .01$, two-tailed
** significant correlation, $p \leq .001$, two-tailed

Principle Analyses[4]

First Analysis. A MANCOVA (Group by Gender by Set by Time with QPO and anxiety covaried) using all dependent measures (SILS Abstraction and Vocabulary, EAS Verbal and Symbolic Reasoning total scores) revealed significant main effects for the within subjects factors Set (Wilks' $F(4,28)=27.54$, $p<.001$) and Time (Wilks' $F(4,28)=4.54$, $p<.01$). A significant Group by Time interaction was also found (Wilks' $F(4,28)=6.80$, $p<.001$).

Subsequent univariate analyses of covariance (Group by Gender by Set by Time ANCOVA with QPO and anxiety covaried) were conducted to determine the influence of the separate dependent measures on the above MANCOVA results. Table 3 presents the means for each of the dependent measures (adjusted for the influence of QPO and Anxiety) at each session and Figures 2 to 8 present the same information graphically. (The unadjusted means and standard deviations for all dependent variables at all sessions are presented in Appendix D, Table 12.)

EAS Symbolic Reasoning. Figure 2 presents the mean EAS Symbolic Reasoning scores for the groups at each session. It is immediately apparent from this figure that the general trend across sessions was an increase in scores. It is also apparent that the two groups showed their greatest difference on Session 4. The alcohol group decreased slightly from the

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[4] F values for all analyses are presented in Appendix E.

Table 3

Means of Dependent Measures Adjusted for Covariates (QPO and Anxiety)

		EAS Symbolic Reasoning			
Group	N	Session 1	Session 2	Session 3	Session 4
		Mean	Mean	Mean	Mean
Control	18	10.76	10.21	11.94	14.43
Alcohol	18	9.13	10.00	12.17	11.12
Total	36	9.94	10.11	12.06	12.78

		EAS Verbal Reasoning			
Group	N	Session 1	Session 2	Session 3	Session 4
		Mean	Mean	Mean	Mean
Control	18	15.75	13.20	13.93	11.98
Alcohol	18	14.36	15.11	13.70	14.47
Total	36	15.06	14.16	13.82	13.23

		Shipley's Abstraction			
Group	N	Session 1	Session 2	Session 3	Session 4
		Mean	Mean	Mean	Mean
Control	18	32.54	34.33	35.39	36.07
Alcohol	18	34.67	34.76	36.96	35.75
Total	36	33.61	34.55	36.18	35.91

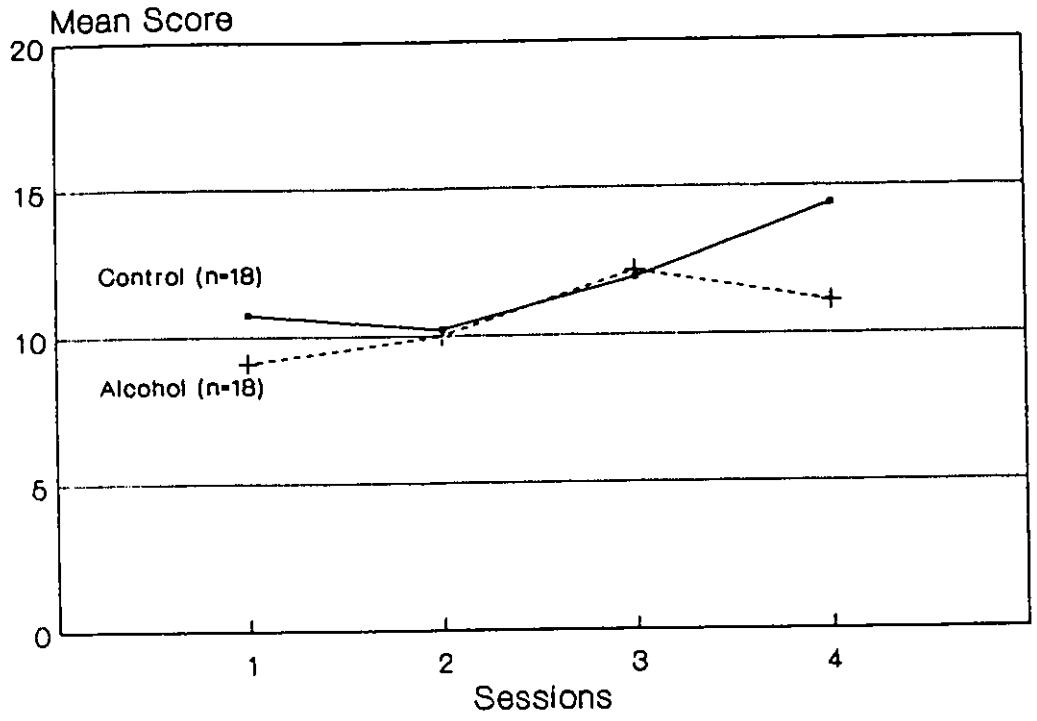
(table continues)

Table 3 (continued)

Means of Dependent Measures Adjusted for Covariates (QPD and Anxiety)

		Shipley's Vocabulary			
Group	N	Session 1	Session 2	Session 3	Session 4
		Mean	Mean	Mean	Mean
Control	18	27.93	29.46	29.83	31.75
Alcohol	18	30.96	34.16	33.59	34.78
Total	36	29.45	31.81	31.71	33.27

Figure 2: Mean EAS Symbolic Reasoning
Alcohol and Control Participants



third to the fourth session (after exposure to alcohol) while the control group continued to improve. The ANCOVA for Symbolic Reasoning revealed a significant main effect for Set ($F(1,31)=12.99$, $p=.005$), but there were no Group, Time or interaction effects revealed. The observed Set effect was caused by the significantly lower scores at Set 1 (sessions one and two) relative to Set 2 (sessions three and four).

Recall that the hypothesis for this study asserted that increased alcohol consumption would result in sober cognitive decrements. Given this explicit prediction and the significant Group by Time interaction observed in MANCOVA, it is appropriate to conduct post hoc tests on these data. Newman-Kuels studentized range statistics were calculated for the Symbolic Reasoning results. Across sessions the Control Group improved significantly from Session 2 to Session 4 ($Q(93)=2.63$, $p<.05$) and from Session 3 to Session 4 ($Q(93)=2.24$, $p<.05$), although not from Session 2 to Session 3. In contrast, the Alcohol Group improved significantly from Session 1 to Session 3 ($Q(93)=2.69$, $p<.05$), followed by a slight, non-significant decline from Session 3 to Session 4. Although no significant between groups differences were observed, overall the Control Group seemed to benefit more from repeated exposure to the test as reflected in their significantly better performance at Session 4 and in their improvement across the last three sessions.

EAS Verbal Reasoning. Figure 3 presents the mean EAS Verbal Reasoning scores for both groups at all four sessions. Note that at the experimental sessions (Sessions 2 and 4) the Alcohol group's performance improved while the Control group's performance worsened, and across all sessions the Control group declined slightly in their scores. The ANCOVA for Verbal Reasoning revealed a significant Group by Time interaction ($F(1,31)=9.19$, $p=.005$). Post Hoc analyses conducted on these data indicated that the Control group's performance decreased significantly at each succeeding session, except between Sessions 2 and 3. That is, the Control group's performance decreased significantly from Session 3 to 4 ($Q(93)=1.3$, $p<.05$), from Session 1 to 3 ($Q(93)=1.56$, $p<.05$), and from Session 1 to 4 ($Q(93)=1.71$, $p<.05$). No significant differences were observed between the groups, nor for the Alcohol group across sessions. In other words, the Control group's performance on this measure deteriorated over time while the Alcohol group's did not. These results are contrary to the predictions of the hypothesis which states that exposure to alcohol should reduce performance.

SILS Abstraction. Figure 4 presents the mean SILS Abstraction scores for the two groups across sessions. The Control participants steadily increased their scores across sessions, but the Alcohol group only improved at Session 3, when no alcohol was available. Further, at one of those

Figure 3: Mean EAS Verbal Reasoning
Alcohol and Control Participants

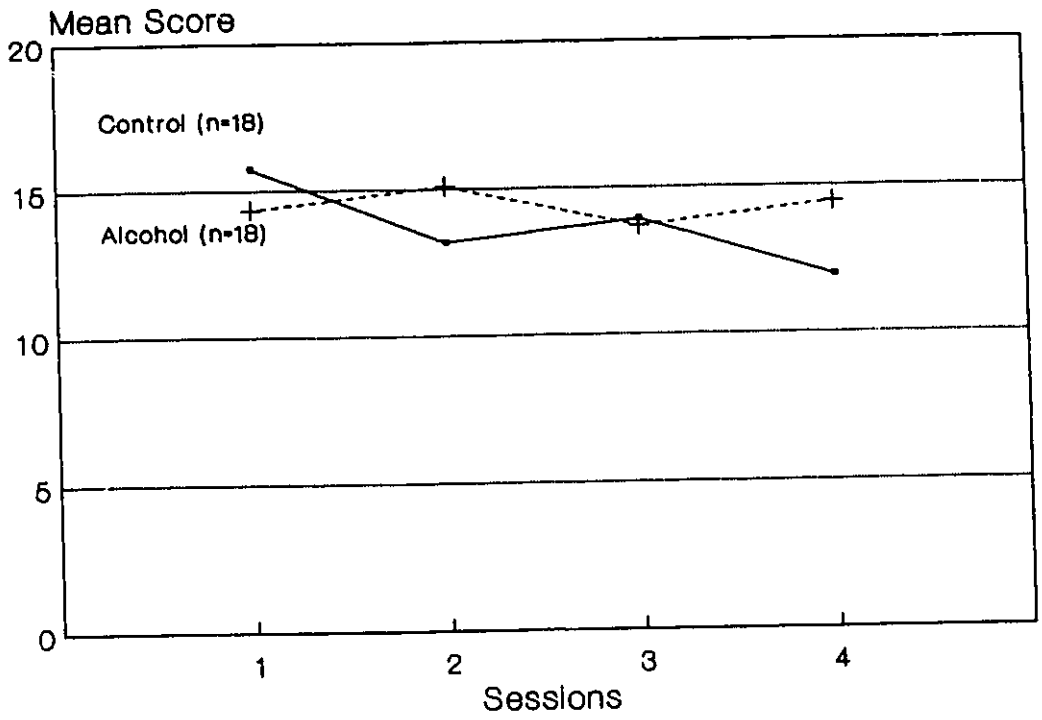
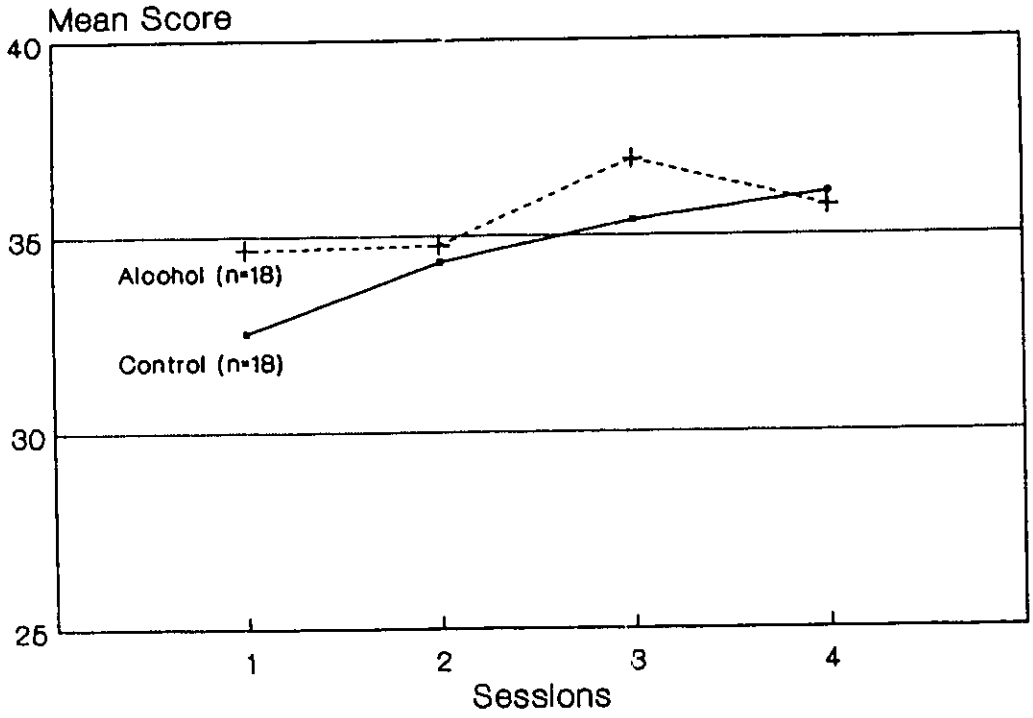


Figure 4: Mean SILS Abstraction Scores
Alcohol and Control Participants



sessions when alcohol was available (Session 4), the mean Abstraction score for the Alcohol group decreased from Session 3. This pattern of performance was, at least partially, consistent with the hypothesis.

The ANCOVA uncovered a significant Set effect ($F(1,31)=29.6$, $p<.001$) similar to that found for EAS Symbolic Reasoning (lower scores at Set 1 (Sessions 1 and 2) than at Set 2 (Sessions 3 and 4)) and a significant Gender by Time interaction ($F(1,31)=4.19$, $p=.049$). The Group by Time interaction approached significance ($F(1,31)=3.92$, $p=.057$), but Post Hoc tests on this measure were nonetheless justified given the specific prediction of the hypothesis.

The Control group showed a significant improvement from Session 1 to Session 2 ($Q(93)=1.27$, $p<.05$), as well as an overall improvement from Session 1 to Session 4 ($Q(93)=1.68$, $p<.05$). In contrast the Alcohol group improved significantly from Session 2 to Session 3, when no alcohol was available, ($Q(93)=1.53$, $p<.05$) but showed no significant improvement from Session 1 to Session 4. In other words, the Alcohol group did not seem to benefit from practice as the Control group did.

To assist in understanding the Gender by Time interaction, performance was plotted for each gender. It is apparent from Figure 5, and from Table 4, that females in the sample performed consistently better than males on this measure, and that the greatest differences were at the

Figure 5: Mean SILS Abstraction Scores
Male and Female Participants

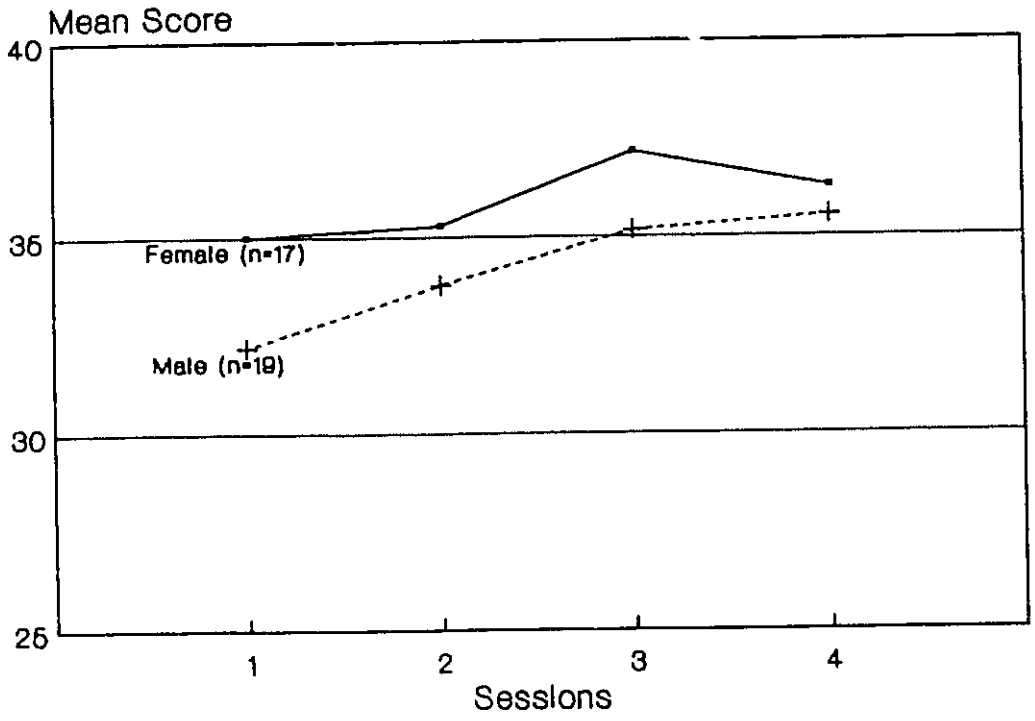


Table 4

Adjusted Means of SILS Abstraction by Gender

Gender	N	Session 1	Session 2	Session 3	Session 4
		Mean	Mean	Mean	Mean
Female	17	35.01	35.30	37.18	36.27
Male	19	32.20	33.79	35.17	35.55
Total	36	33.61	34.55	36.18	35.91

baseline sessions (Sessions 1 and 3). The males, in contrast, showed a steady improvement across sessions. However, because the gender distribution was not proportional (i.e., more females that males in the Control group and more males than females in the Alcohol group) this gender effect may have masked group effects such as the Group by Time interaction ($F(1,31)=3.92$, $p=.057$). Hence separate ANCOVAs were conducted for the males and the females in the sample. The adjusted means are presented in Table 5.

SILS Abstraction: Females. The ANCOVA conducted on the female participants only revealed a significant main effect for Set ($F(1,14)=5.48$, $p=.035$). This was the only observed significant effect for the female sub-sample (see Figure 6) and indicates better performance at the later sessions. This was a different pattern of performance than that shown by the males in the sample: Aside from the Set effect, no between group nor between session differences were observed for the females.

SILS Abstraction: Males. SILS Abstraction performance for the males is presented in Figure 7. At the baseline sessions (one and three) the Alcohol group performed better than the Control group. After exposure to alcohol (Sessions 2 and 4) the Control group performed better than the Alcohol group.

The ANCOVA for the males only revealed main effects for Set ($F(1,16)=52.68$, $p<.001$) and Time ($F(1,16)=4.57$, $p=.048$),

Figure 6: Mean SILS Abstraction Scores
Female Participants

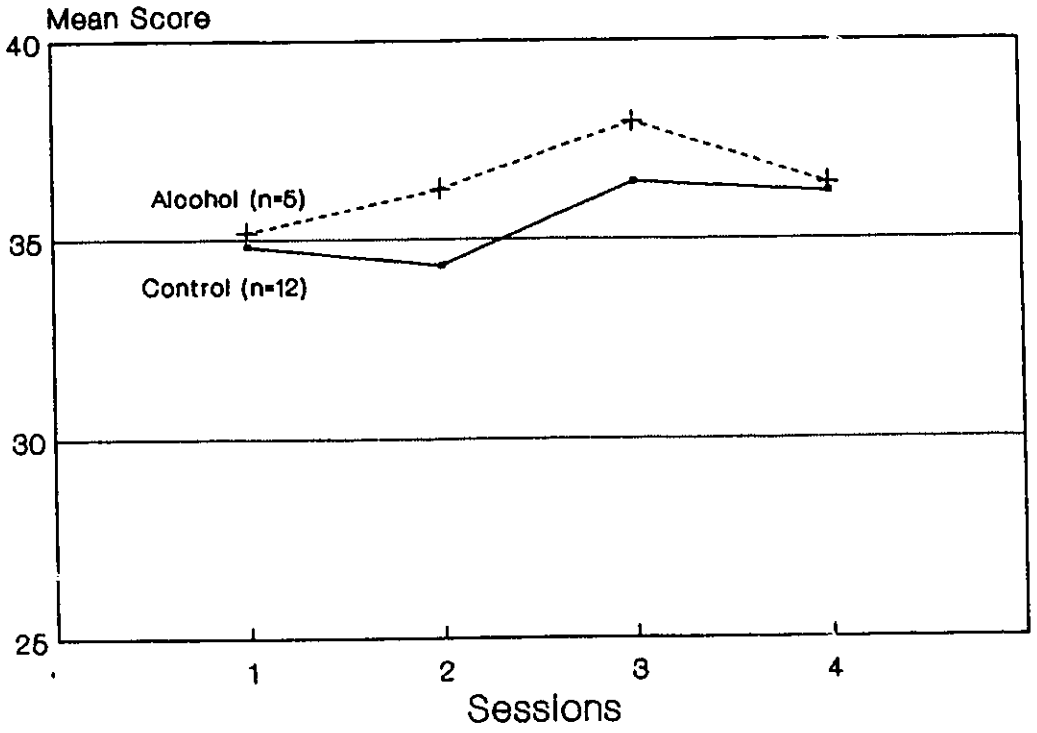


Figure 7: Mean SILS Abstraction Scores
Male Participants

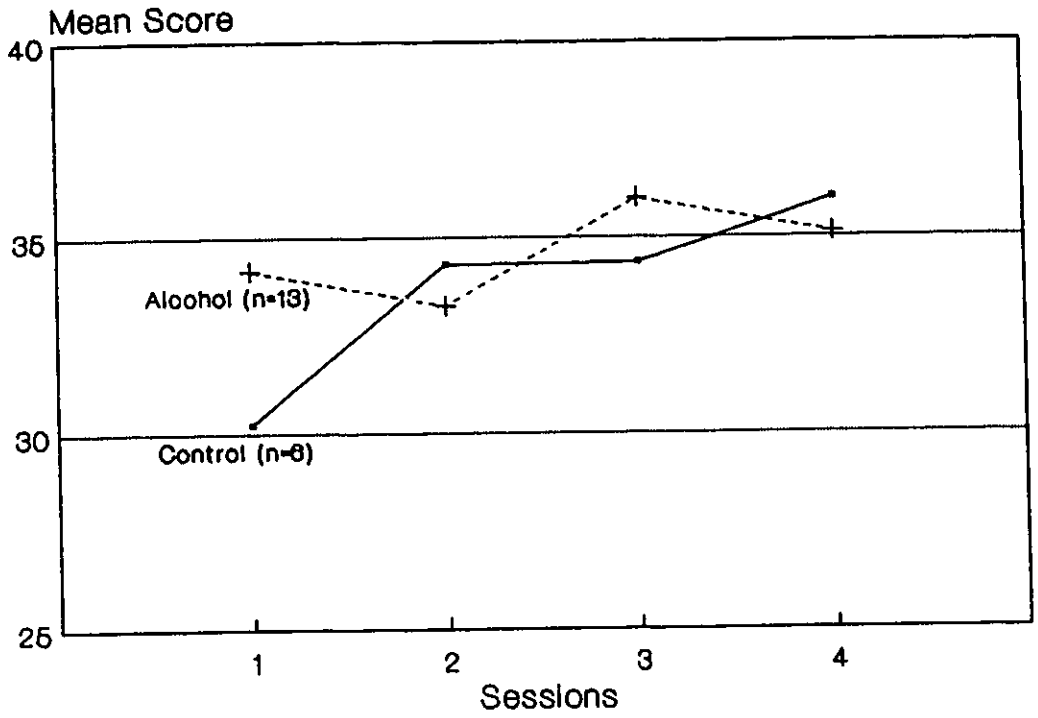


Table 5

Adjusted Means of SILS Abstraction by Gender and Group

Gender		Session 1	Session 2	Session 3	Session 4
		Mean	Mean	Mean	Mean
Female	Control	34.83	34.34	36.42	36.16
	Alcohol	35.18	36.25	37.94	36.39
Male	Control	30.24	34.31	34.36	35.98
	Alcohol	34.15	33.26	35.99	35.12

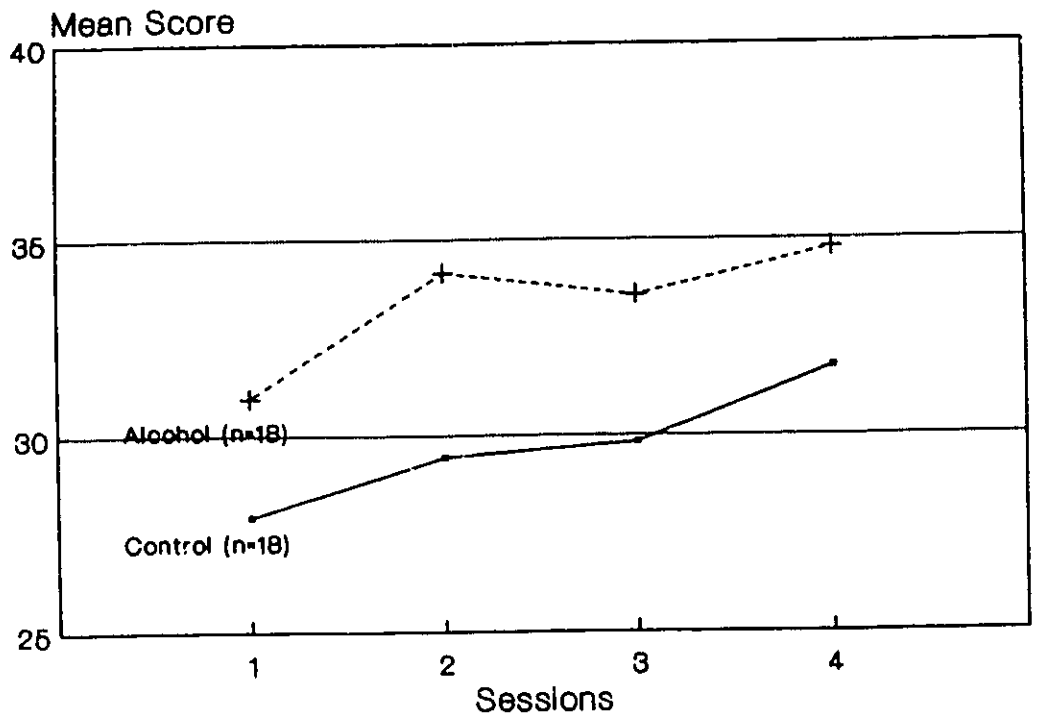
as well as a significant Group by Time interaction ($F(1,16)=6.60$, $p=.021$). Thus the tendency to improve at later sessions, regardless of group, was found to be significant for the males (see Figure 6). However, the interaction of Group and Time suggests that Group did have an important impact on performance.

Post Hoc analyses of the male data indicates that the Control group improved at succeeding sessions. Thus, Session 2 performance was significantly better than Session 1 performance ($Q'63)=1.95$, $p<.05$), as was Session 3 ($Q(63)=2.37$, $p<.05$), and Session 4 ($Q(63)=2.57$, $p<.05$). The Alcohol group displayed no such improvement over time. Following a non-significant decline in performance from Session 1 to Session 2, these participants showed a significant improvement from Session 2 to Session 3 ($Q(63)=2.57$, $p<.05$), when no alcohol was available. Other than this increase, the Alcohol group's performance did not differ from Session 1 to Session 4.

SILS Vocabulary. Figure 8 presents the mean SILS Vocabulary scores for the groups at each session. It appears that the groups began with different scores and remained roughly parallel from session to session.

This impression was confirmed by a significant Group effect ($F(1,30)=5.64$, $p=.024$) from the ANCOVA. As well as the significant Group effect, significant main effects for Set ($F(1,31)=34.41$, $p<.001$) and Time ($F(1,31)=19.24$, $p<.001$)

Figure 8: Mean SILS Vocabulary Scores
Alcohol and Control Participants



were also revealed. It appears that the smallest group difference was at Session 1 (which is consistent with the earlier reported finding that the groups did not differ significantly on the unadjusted scores measured at baseline) and that both groups improved their scores at Session 2.

Post Hoc analyses on these data revealed significant between group differences at each session ($Q(123)=2.75$, $p<.05$), and showed that both groups improved significantly from the beginning to the end of the study ($Q(93)=1.82$, $p<.05$). However, the Control group improved significantly at almost every succeeding session (the only exception was between Sessions 2 and 3) while the Alcohol group improved significantly from Session 1 to Session 2 and thereafter performed essentially the same at all other sessions. For all of these effects, improved performance (i.e. higher scores) occurred at later sessions.

First Analysis Summary. As noted earlier, the MANCOVA conducted on these data revealed significant main effects for Set and Time as well as a significant Group by Time interaction. The subsequent univariate ANCOVAs indicated that variance in the dependent measures EAS Symbolic Reasoning, SILS Abstraction, and SILS Vocabulary contributed directly to the revealed multivariate Set effect. Each of these measures reflected better performance at Set 2 (Sessions 3 and 4 combined). In other words, cognitive

performance was better at the two later sessions than at the earlier sessions.

The MANCOVA Time effect also suggests improved performance at later sessions. SILS Vocabulary contributed directly to the MANCOVA Time effect while EAS Verbal Reasoning (ANCOVA Group by Time) and SILS Abstraction (ANCOVA Gender by Time) contributed less directly. These suggest that baseline scores (Sessions 1 and 3) were generally lower than scores at the experimental sessions (Sessions 2 and 4).

Finally, the MANCOVA Group by Time interaction seemed to be based primarily on EAS Verbal Reasoning (ANCOVA Group by Time) and to a lesser extent on SILS Vocabulary (ANCOVA main effects for Time and Group). When considering the Verbal Reasoning results, it appears that the Alcohol group showed none of the deterioration in performance shown by the Control group. This difference may account for the significant Group by Time MANCOVA interaction. However, it is also worth remembering that analysis of SILS Abstraction scores for the males only revealed a significant Group by Time interaction. This effect may have been hidden by the Gender by Time interaction which was revealed when both males and females were included in the analysis. This interaction clearly indicated that the alcohol group did not benefit from exposure to the task until Session 3, while the Control group improved earlier.

Second Analysis. Another set of analyses was conducted focussing exclusively on the alcohol group. These were intended to directly address the hypothesis that relatively small increases over usual consumption levels produces sober cognitive decrements. Table 6 presents the adjusted means (adjusted for the influence of QPO and Anxiety) for the two alcohol sub-groups on all the dependent measures. Not all participants in the Alcohol group increased their alcohol consumption beyond their QPO when allowed the opportunity, so this analysis was limited to those who actually did increase their drinking. Six of the Alcohol group drank more than their usual QPO at the first experimental session ('Session 2 increasers') and eight participants increased their consumption at the second experimental session ('Session 4 increasers'). Four participants consumed the same amount of alcohol at both experimental sessions and were dropped from this analysis. The sample size for this analysis was reduced further by another factor as well.

After viewing the adjusted means presented in Table 7, it became apparent that the results might have been overly influenced by gender than by alcohol consumption. Although supportive of the hypothesis, these results might well have resulted directly from the influence of the one female in the 'Session 2 increasers' group. Thus, the remaining three females were dropped from the sample and the analyses re-run with only the males.

Table 6

Means of Dependent Measures Adjusted for Covariates (GPO and Anxiety): Alcohol Sub-Groups

		EAS Symbolic Reasoning			
Group	N	Session 1	Session 2	Session 3	Session 4
Session 2 Increase	6	10.04	8.33	8.87	8.69
Session 4 Increase	8	5.23	10.53	13.78	14.85
Combined	14	7.64	9.43	11.33	11.77

		EAS Verbal Reasoning			
Group	N	Session 1	Session 2	Session 3	Session 4
Session 2 Increase	6	12.02	13.56	12.31	12.62
Session 4 Increase	8	14.59	16.55	12.41	16.08
Combined	14	13.31	15.06	12.36	14.35

(table continues)

Table 6 (continued)

Means of Dependent Measures Adjusted for Covariates (QPO and Anxiety; Alcohol Sub-Groups

		Shipley's Abstraction			
Group	N	Session 1	Session 2	Session 3	Session 4
Session 2 Increase	6	32.53	32.37	35.35	34.07
Session 4 Increase	8	35.29	34.47	37.15	34.97
Combined	14	33.91	33.42	36.25	34.52

		Shipley's Vocabulary			
Group	N	Session 1	Session 2	Session 3	Session 4
Session 2 Increase	6	30.52	35.32	34.05	35.21
Session 4 Increase	8	30.34	32.90	34.50	34.68
Combined	14	30.43	34.11	34.28	34.95

Table 7
Means of Dependent Measures Adjusted for Covariates (GPD and Anxiety); Alcohol Sub-Groups by Gender

			EAS Symbolic Reasoning			
Group	Gender	N	Session 1	Session 2	Session 3	Session 4
Session 2 Increase	M	4	12.74	7.85	11.72	9.48
	F	2	7.33	8.81	6.01	7.89
Session 4 Increase	M	7	13.26	10.89	14.85	14.62
	F	1	-2.79	10.16	12.70	15.08

			EAS Verbal Reasoning			
Group	Gender	N	Session 1	Session 2	Session 3	Session 4
Session 2 Increase	M	4	12.75	14.19	12.38	13.20
	F	2	11.30	12.92	12.24	12.04
Session 4 Increase	M	7	15.60	17.15	15.01	16.60
	F	1	13.57	15.96	9.80	15.55

(Table Continues)

Table 7 (Continued)

Means of Dependent Measures Adjusted for Covariates (GPO and Anxiety): Alcohol Sub-Groups by Gender

			SILS Abstraction			
Group	Gender	N	Session 1	Session 2	Session 3	Session 4
Session 2 Increase	M	4	31.47	31.56	32.59	32.84
	F	2	33.60	33.15	38.11	35.29
Session 4 Increase	M	7	36.05	35.71	38.91	37.00
	F	1	34.53	33.22	35.40	32.94

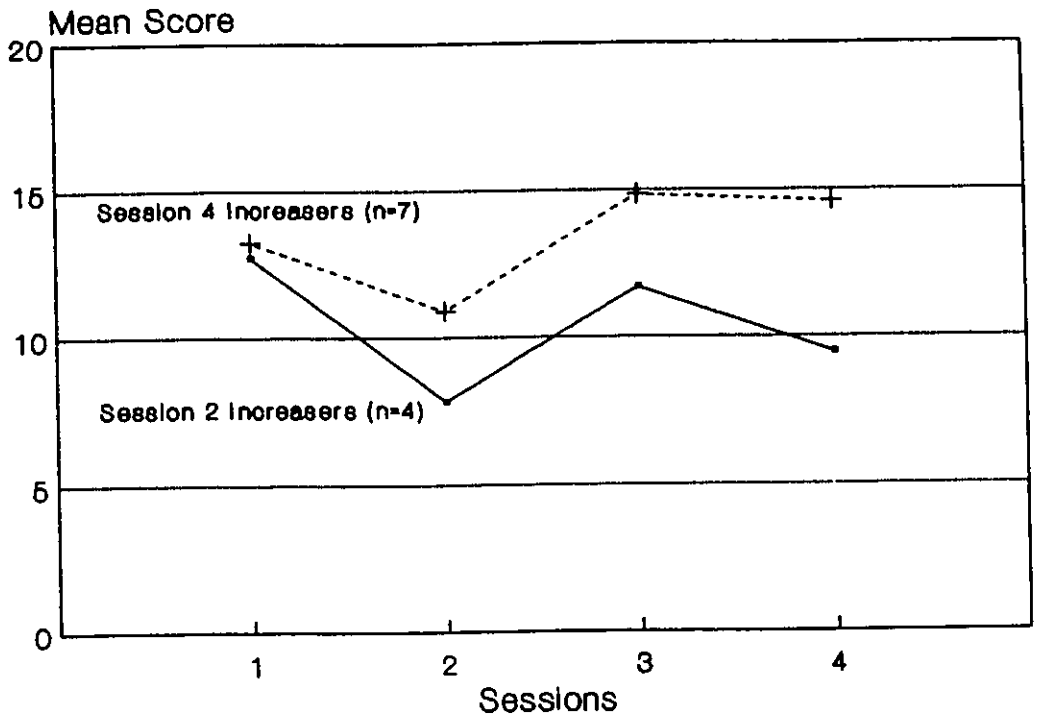
			SILS Vocabulary			
Group	Gender	N	Session 1	Session 2	Session 3	Session 4
Session 2 Increase	M	4	30.74	35.91	33.77	33.85
	F	2	30.30	34.73	34.33	36.06
Session 4 Increase	M	7	34.11	34.72	33.58	35.52
	F	1	26.57	31.08	35.42	34.36

The new MANCOVA model dropped Gender as a factor and used a Group by Set by Time (2 X 2 X 2) design. Significant effects for Set (Wilks' $F(4,5)=13.64$, $p=.007$), Time (Wilks' $F(4,5)=38.83$, $p=.001$), and Group by Time interaction (Wilks' $F(4,5)=8.60$, $p=.018$) were observed. Subsequent univariate analyses were conducted for the separate dependent measures.

EAS Symbolic Reasoning. Figure 9 presents the mean EAS Symbolic Reasoning performance for the Alcohol sub-groups at each of the sessions. As is readily apparent from this figure, the two groups performed much the same at Session 1, but tended to diverge over succeeding sessions. When initially exposed to alcohol both groups showed a decrease in performance, but those who drank more than their usual showed a greater decline. Both groups then recovered and improved their scores by Session 3. When they were next exposed to alcohol (Session 4), however, the Session 2 Increasers showed a decline in performance while the Session 4 Increasers showed an almost imperceptible decline. It is also worth noting that the Session 2 Increasers never exceeded their performance at Session 1, while the Session 4 Increasers did.

The ANCOVA for EAS Symbolic Reasoning revealed a significant main effect for Set ($F(1,8)=6.79$, $p=.031$). This resulted from lower Set 1 (Sessions 1 and 2 combined) than Set 2 (Sessions 3 and 4 combined) performance. No other differences were observed from the ANCOVA, and Post Hoc tests revealed no within or between group differences.

Figure 9: Mean EAS Symbolic Reasoning
Alcohol Sub-Groups, Males



EAS Verbal Reasoning. Figure 10 presents the mean scores for EAS Verbal Reasoning. Both sub-groups improved at about the same rate from Session 1 to Session 2, though they appear to be consistently different. At Session 3 the sub-groups showed a parallel decrease in performance. At Session 4 both sub-groups again showed an improvement in performance. Paradoxically, this pattern suggests improvement following alcohol consumption and deterioration following abstinence. However, while such a pattern is interesting, it was not supported by ANCOVA or Post Hoc analyses. The groups performed equally well at all sessions.

SILS Abstraction. Figure 11 presents the mean SILS Abstraction scores for the alcohol sub-groups at each session. The predominant feature of this figure is the large improvement by the Session 4 Increasers at Session 3. The two groups showed a slight decline at the first exposure to alcohol, but then improved at apparently different rates.

One significant effect was observed from the ANCOVA; a main effect for Set ($F(1,8)=15.40$, $p=.004$). This Set effect resulted from higher scores at Set 2 (Sessions 3 and 4 combined) than Set 1 (Sessions 1 and 2 combined).

Post Hoc analyses indicated that those who did not drink more than their usual QPO improved significantly from Session 2 to Session 3 ($Q(24)=2.7$, $p<.05$) and at that point were significantly different from the Session 2 Increasers ($Q(31)=6.32$, $p<.05$). Again, it appears that early exposure

Figure 10: Mean EAS Verbal Reasoning
Alcohol Sub-Groups, Males

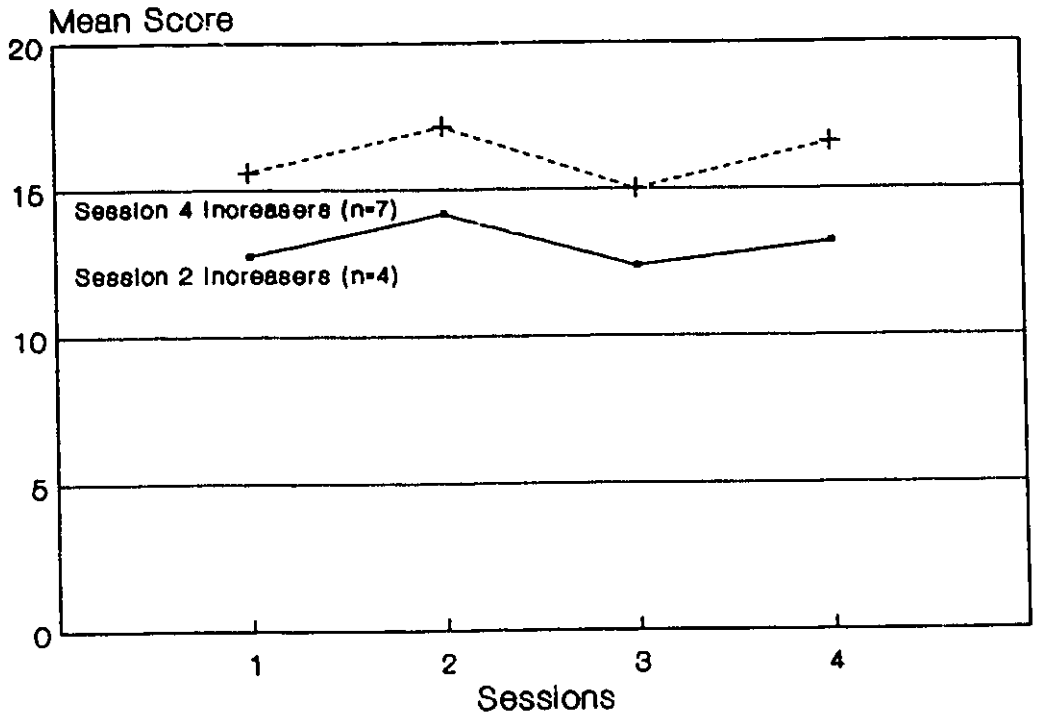
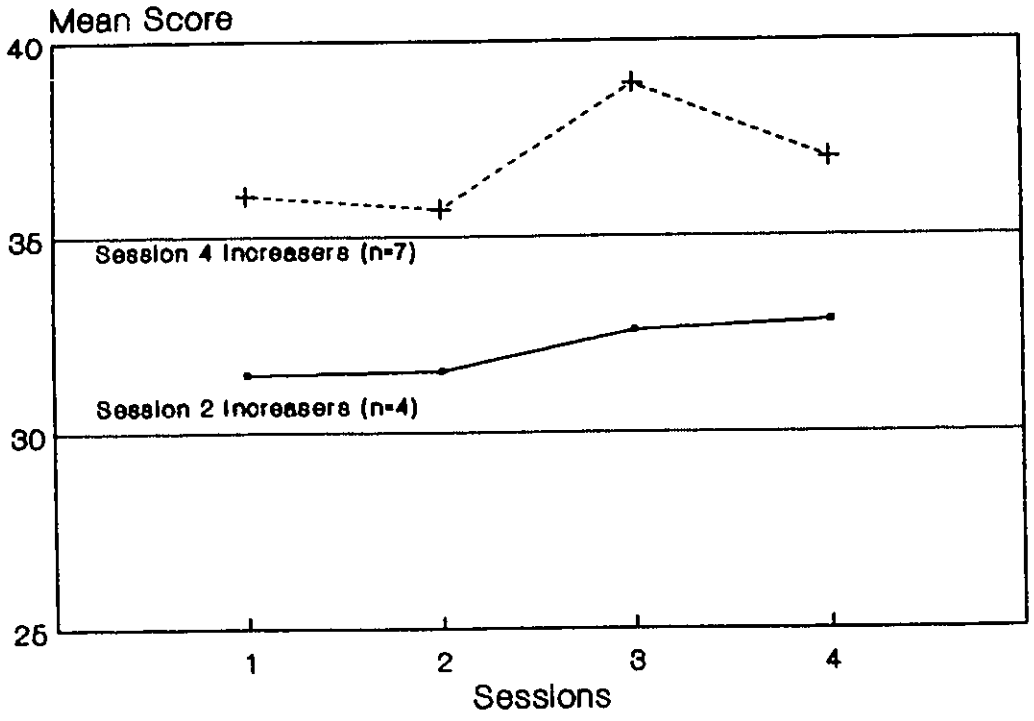


Figure 11: Mean SILS Abstraction Scores
Alcohol Sub-Groups, Males



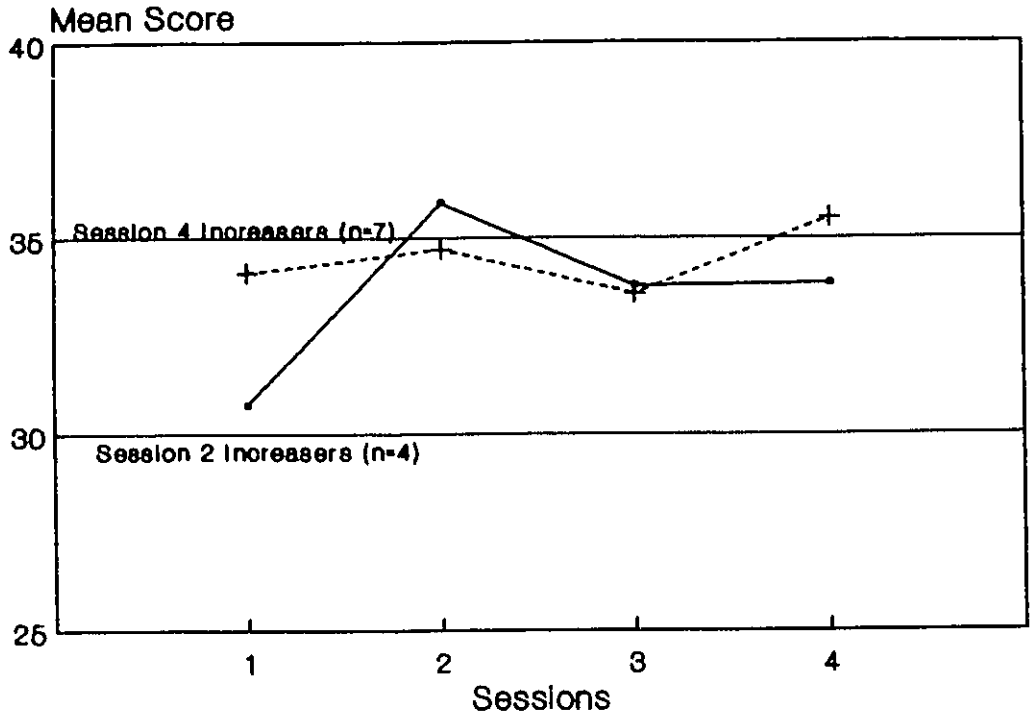
to greater than usual amounts of alcohol inhibited practice effects.

SILS Vocabulary. Figure 12 presents the alcohol subgroups' mean performance on SILS Vocabulary at each session. It appears from this figure that the Session 2 Increasers improved from Session 1 to Session 2 and then their performance leveled off. The Session 4 Increasers made their largest improvement between sessions three and four. The greatest increases for both groups occurred following exposure to alcohol levels above their QPO.

The ANCOVA for SILS Vocabulary revealed a significant main effect for Time ($F(1,8)=23.87$, $p=.001$), and significant Set by Time ($F(1,8)=8.09$, $p=.022$), and Group by Set by Time interactions ($F(1,8)=7.34$, $p=.027$). Post Hoc analyses indicated a significant Group difference only at Session 1 ($Q(31)=3.96$, $p<.05$), with Session 4 Increasers scoring higher than Session 2 Increasers. These analyses also indicated that the Session 4 Increasers did not vary significantly from session to session. The Session 2 Increasers, however, displayed significantly better performance at Session 2, ($Q(24)=2.81$, $p<.05$), Session 3 ($Q(24)=2.11$, $p<.05$), and Session 4 ($Q(24)=2.55$, $p<.05$) than at Session 1.

Second Analysis Summary. Recall that the MANCOVA results from this the Third Analysis resulted in significant observed effects for Set, Time, and Group by Time. When the separate ANCOVA results are viewed in this context a number

Figure 12: Mean SILS Vocabulary Scores
Alcohol Sub-Groups, Males



of conclusions can be drawn. The observed Set effect from the MANCOVA was likely due to variations in two of the dependent variables; EAS Symbolic Reasoning, and SILS Abstraction (each of which was found to have a significant main effect for Set in their respective ANCOVAs). Only the SILS Vocabulary ANCOVA revealed a significant Time or a Set by Time effect. Hence, the observed MANCOVA Time and Set by Time effects were due mostly to variations in SILS Vocabulary performance. The Group by Time MANCOVA result was also apparently due to variations in SILS Vocabulary, but might also have been influenced by SILS Abstraction performance. Although no overall Group or Time effect was revealed in this ANCOVA, Post Hoc analysis did reveal the presence of a between group difference at Session 1, and significant within group differences for the Session 2 Increasers.

CHAPTER IV

Discussion

The purpose of the present study was to investigate the relationship between social drinking and sober cognitive functioning. By controlling access and exposure to alcohol two questions were to be addressed. First, is there a causal relationship between alcohol consumption and later sober cognitive functioning? Second, does an increase in alcohol consumption, beyond that which an individual normally consumes, produce decrements in sober cognitive functioning? On the basis of information derived from the present study it is now possible to answer these questions. They will be discussed in order.

The observed results clearly indicate that social drinking does have an impact on sober cognitive functioning. However, this influence was not unidirectional but, rather, depended on the nature of the specific task. That is, performance on the dependent measures varied differently across sessions for the Alcohol group and the Control group.

At the broadest level of cognitive functioning assessed in this study, MANCOVA results from the First Analysis showed significant main effects for Set and Time. More convincingly, the observed Group by Time interaction reflected this alcohol effect. Recall that the Time factor in the MANCOVA compared performance at the two baseline sessions with performance at the two experimental sessions

while the Group factor referred to whether or not participants were exposed to alcohol. By definition, then, the observed Group by Time interaction reflected the impact of alcohol consumption and, hence, the hypothesis is supported.

Although these results meet the necessary and sufficient conditions for claiming that social drinking has an impact on subsequent sober cognitive functioning, they do not describe this phenomenon. To assist in this description the results from the supplemental ANCOVA's are reviewed below.

A Review of the Results

First Analysis. Sober performance on SILS Vocabulary was unaffected by prior alcohol consumption (see Figure 8). Although the Alcohol group performed consistently better than the Control group, both improved equally across sessions. Thus, the two groups seemed to benefit about equally well from practice.

Although the only observed EAS Symbolic Reasoning effect was for Set, Post Hoc analyses revealed a subtle alcohol influence. The Control participants improved their performance from Session 2 to Session 4. The Alcohol group showed a different pattern in that they improved only from Session 1 to Session 3 (see Figure 2). Thus the Control Group, as reflected in their significantly better performance at Session 4 and in their improvement across the last three

sessions, seemed to benefit more than the Alcohol group from repeated exposures to the tests.

Some of the most interesting findings were for EAS Verbal Reasoning. A significant Group by Time interaction was observed and Post Hoc analyses indicated that this was caused by the fairly consistent decline over sessions by the Control group in contrast to the stable performance by the Alcohol group. The only session at which the Alcohol group showed a significant decrease in performance was Session 3, when they had no access to alcohol. It appears that exposure to alcohol at Sessions 2 and 4 somehow inoculated the Alcohol group members against whatever deteriorative influences caused the decline in Control group performance. The significant Group by Time interaction observed in the ANCOVA thus reflected better performance by the Alcohol group when they were exposed to alcohol. On this measure at least, sober cognitive functioning was maintained by exposure to alcohol.

Separate ANCOVAs were conducted for males and females on SILS Abstraction. ANCOVA for the females only revealed a main effect for Set, indicating better performance at the latter two sessions. Thus, the females in the sample were unaffected by exposure to alcohol on this measure.

In contrast, ANCOVA for the males revealed main effects for Set and Time and a significant Group by Time interaction. The Control group improved significantly from Session 1 to

Sessions 2, 3, and 4. In contrast, the Alcohol group showed only one significant increase in performance; Session 2 to Session 3, when no alcohol was available. Interestingly, each time the Alcohol group was exposed to alcohol their performance was poorer than the Control group, but when no alcohol was available, they performed better than the Controls. Over the course of the study the Control group males benefited from repeated exposures to the task while the Alcohol group males showed no such benefit. In effect, exposure to alcohol prevented participants from benefiting from practice.

In general, except for EAS Verbal Reasoning where they performed more poorly over time, the Control group improved their performance with repeated exposures to the tests. In contrast, the Alcohol group seemed to benefit much less, if at all, from practice on these tasks. The only exception to this was for SILS Abstraction where the Alcohol group females performed more like the Control group than the Alcohol group males.

Second Analysis. The main hypothesis for the present study gave rise to the second question mentioned above. The hypothesis states that increased alcohol consumption above one's QPO will produce decrements in sober cognitive functioning, especially in abstract functioning.

The methodology employed in the present study manipulated exposure to alcohol within the Alcohol group.

However, the ethical necessity of limiting the maximum, but not the minimum, allowable consumption restricted the number of participants who could ultimately be included in this analysis. As well, those female participants who's drinking pattern otherwise met the inclusion criteria were dropped from this analysis because they (particularly the one female in the Session 4 Increasers) were outliers in the data set. Their inclusion in the analysis could have exaggerated the influence of alcohol on sober cognitive performance. A brief view of Table 6 should be convincing in this matter. The one female included in the Session 4 Increase group produced an adjusted score on Session 1 EAS Symbolic Reasoning of -2.79. The impact of this performance was to decrease the overall group mean from 13.26 to 5.23. This so skewed the results that her expected regression toward the mean at session two could be mistaken for a significant alcohol effect. Therefore, all females were dropped from the analysis and only the remaining male sub-sample included.

MANCOVA conducted on this sample resulted in significant main effects for Set and Time as well as a significant Group by Time interaction. A brief review of the supplemental ANCOVA and Post Hoc analyses helps in interpreting these MANCOVA results.

EAS Symbolic Reasoning performance, while showing an interesting pattern of steadily diverging scores between the two groups, did not seem to be influenced by the different

exposures to alcohol. The only significant result was an ANCOVA main effect for Set, indicating better performance at the latter two sessions for all participants.

No significant results were observed for EAS Verbal Reasoning. The two groups performed equally well at all sessions on this measure.

ANCOVA conducted on SILS Vocabulary revealed a significant Group by Set by Time interaction. Post Hoc analyses indicated that this result was due primarily to variations in performance by participants in the Session 2 Increasers group. These individuals scored significantly lower than the Session 4 Increasers at Session 1, but then improved significantly from Session 1 to Session 2 (see Figure 12). Thereafter they showed no significant change in performance at any subsequent session. In contrast, the Session 4 Increasers showed no significant change in their performance over time. These results are inconsistent with the hypothesis in that improved performance occurred when participants were allowed to increase their alcohol consumption.

The description of performance on SILS Abstraction was deliberately left to the last for two reasons. First, it was on this measure that earlier researchers observed significant variations as a function of alcohol consumption (e.g. Parker & Noble, 1977; MacVane et al, 1982; Parker et al, 1982). Second, the main hypothesis for the present study predicts a

specific decrease in abstract functioning. Thus, if alcohol were to have a negative impact on cognitive functioning, it should be apparent in SILS Abstraction performance.

ANCOVA conducted on SILS Abstraction resulted in only one observed significant effect. This was for Set and it reflected the beneficial impact of practice on performance. However, to adequately evaluate the hypothesis a more detailed evaluation of performance on this measure is necessary.

Post Hoc analyses of SILS Abstraction clearly show that those participants exposed to only their QPO at Session 2 improved significantly at Session 3. In other words, Session 4 Increasers had benefited from practice at Session 3 and their performance was significantly better than the Session 2 Increasers at this point. In contrast, those participants who received more than their QPO at Session 2 showed no significant improvement in performance at any session.

At this point there appears to be adequate information to explain the MANCOVA results. The Set effect reflected general improvement in performance at the later sessions and was consistent with expected practice effects. Variations in performance on SILS Abstraction, EAS Symbolic Reasoning, and to a lesser extent SILS Vocabulary accounted for the observed Set effect.

The MANCOVA Time effect likely resulted from variations in SILS Vocabulary, the only measure on which a significant

Time effect was observed from the ANCOVA. It is apparent from Figure 10 that performance on this measure at the baseline sessions (1 and 3) was lower than at the experimental sessions (2 and 4). It seems that when exposed to alcohol, whether or not such exposure was greater than usual consumption levels, participants improved their performance on this test of vocabulary.

The most interesting MANCOVA result was the significant Group by Time interaction. This would be the expected interaction if the hypothesis were to be supported, but it is necessary to determine if it reflected the predicted direction of change before claiming support for the hypothesis.

The Group by Time interaction was due mainly to changes in SILS Vocabulary; the only measure on which this interaction was observed in the univariate analyses. The pattern of results indicated that participants who were exposed to increases in alcohol consumption at Session 2 significantly improved their vocabulary scores from Session 1 to Session 2. Such an improvement is contrary to the prediction of general decrements in cognitive functioning, but should not be seen as an adequate test of the hypothesis. SILS Vocabulary alone cannot be the basis for conclusions about the hypothesis because decrements in abstract functioning were explicitly predicted and SILS Vocabulary is not a measure of abstract functioning.

More appropriately, on the basis of the observed variations in SILS Abstraction, one possible conclusion here is that sober abstract functioning was adversely affected by the consumption of greater than usual amounts of alcohol. This conclusion is based on an observable inconsistency in performance rather than on an observable decrement in performance. That is, exposure to alcohol at QPO or greater than QPO levels resulted in no significant change in Abstraction scores from Session 1 to Session 2. At the following session (Session 3), when no one was exposed to alcohol, those who had received more than their QPO (Session 2 Increasers) again showed no change in their performance. However, those who received only their QPO at Session 2 (Session 4 Increasers) improved significantly at Session 3, and their scores were significantly better than the Session 2 Increasers. The observed decrements were not absolute in nature but, rather, were relative to the expected level of performance on SILS Abstraction.

When placed in the context of the literature, the above results should not seem surprising. SILS Abstraction performance, by males especially, is the measure which has most frequently reflected the greatest decrement in abstract functioning (e.g. Parker and Noble, 1977; MacVane et al, 1982). The observed variations in SILS Vocabulary performance are also consistent with earlier findings. Carey and Maisto (1987) found that SILS Vocabulary was lower in

non-drinkers and did not improve with practice while all other cognitive measures did.

The difficulty with previous research in this area is twofold. First, the earlier studies which uncovered the apparent effect of social drinking on sober functioning utilized a single test session and ran correlational analyses. They did not design and conduct studies to test the causal conclusions which they were drawing. Later studies did attempt to test the causal hypothesis (Birnbaum et al, 1983; Hannon et al 1985; Carey & Maisto, 1987) by employing a reversibility design. However, the difficulty with such a design is that it assumes decreased alcohol consumption will have the precisely opposite effect of increased consumption. They did not take into account the effects of tolerance and hence the removal of alcohol had no observable effect and could not provide an adequate test of the causal hypothesis.

The present study corrected these problems by exposing participants to alcohol and by taking into account the influence of tolerance. That there was a change in sober cognitive functioning has been demonstrated. Now the question is why such results were observed.

Alternate Explanations

There are two basic categories of explanation which could be applied to the present results. First, there are those explanations which cite inherent group differences as

the causative agents for any observed alterations in performance. From this perspective the observed results might have been the consequence of gender differences.

As noted earlier, the distribution of gender was unequal in the present study. It might be argued that the observed effects were the result of there being more females in the Control group and more males in the Alcohol group. The difficulty with this contention, however, is that only one significant gender effect was observed in all of the analyses; the Gender by Time interaction in the supplemental SILS Abstraction ANCOVA. Once this was observed, the analysis was re-run separately for males and females. Thus, although there was an obvious difference in distribution, statistical controls were employed so that the effects of alcohol could be distinguished from gender effects. As a consequence, there is no basis for contending that the observed results were due to gender.

The second category of explanations are those which assert that the groups received systematically different treatment in some important way. If it can be shown that such an important treatment difference existed, other than alcohol, then the observed results and conclusions must be called into question. Two potential treatment confounds must be addressed here.

First, the experimenter had different amounts of contact with the two groups and it might be argued that such contact

had some influence on performance. The design of the study required that the experimenter be in contact with participants in the Alcohol group much more than with the other participants. It is possible that because of this contact participants in the Alcohol group attempted to provide test results which were consistent with what they believed the experimenter wanted. The difficulty is that the observed results are quite varied. For this explanation to be valid, the participants would have needed to perceive that a specific pattern of test scores was required and to achieve this by performing less well on some tasks and better at others, while varying this from session to session. Although this is possible, it depends on the participants having a sophisticated awareness of what the desired behaviour was to be, and this is unlikely.

It might also be argued that the Alcohol participants would try to do better because of the more frequent contact. Again, although it is possible, it seems doubtful that the observed variations in performance resulted from the Alcohol group's higher motivation. Their performance was not consistently better than Control participants.

A final alternate explanation is that the time of testing could account for the results. The Control group was tested on Fridays at two o'clock in the afternoon and the Alcohol group was tested on Mondays at noon. It is possible that performance at the end of the week might be different

from performance after a weekend. However, if there was a systematic effect on performance it was quite subtle. In this case the practical demands of the study (i.e. maximizing the likelihood that Control participants would refrain from alcohol consumption for 48 hours prior to testing) warranted the inclusion of a systematic difference in treatment. Including a time-of-testing confound was determined to be less of a risk to the study than asking Control participants to remain abstinent for an entire weekend.

The above alternate explanations cannot adequately account for the observed results. There was no important variable on which the two groups were different which was not controlled, and there was no systematic difference in treatment which could account for the observed results. Thus, it is appropriate to conclude that changes in performance were the result of exposure to alcohol.

A Model of Alcohol Based Cognitive Interference

The apparent anomaly of alcohol exposure enhancing performance on some tasks (EAS Verbal Reasoning and SILS Vocabulary) and inhibiting performance on others (EAS Symbolic Reasoning and SILS Abstraction) seems confusing at first. However, these apparently paradoxical results are useful precisely because the alcohol effect differs on the tasks. An evaluation of the tasks provides useful information concerning the actual impact of alcohol consumption on sober cognitive performance.

The SILS Vocabulary and EAS Verbal Reasoning tests both present test stimuli in a verbal, linguistically familiar way. SILS Vocabulary requires the participant to read a short list of words, compare these with a target word, and choose the word from that list which most closely matches the meaning of the target word. This is basically a recognition task designed to assess word knowledge.

EAS Verbal Reasoning presents the participant with a set of verbally stated facts and then provides a list of statements related to these facts. The participant's task is to evaluate each statement and to decide if it is valid, invalid, or if it is impossible to determine the validity of the statement. In essence, this is a test of verbally based abstract problem solving.

The important point to consider is that, while the tasks are different, both of these tests present their stimuli in a verbal format. The participant in both cases is asked to manipulate information using symbols which are very familiar - words. That is, participants perform in a realm that employs over-learned symbols, and because of the nature of the stimuli (or symbols) employed, they are free to attend to the task at hand.

The other two tests of abstract functioning, EAS Symbolic Reasoning and SILS Abstraction employ less familiar symbols. SILS Abstraction presents a sequence of symbols with the final item missing. The task is to determine the

rule for the sequence and to fill in the missing item. However, while the symbols and the sequence are initially familiar (e.g. 1 2 3 __), the rules for determining the sequence quickly become less familiar. That is, the familiar symbols are employed in such a way that the usefulness of associated old knowledge is minimized. A successful participant must suspend the old associations and allow the presented sequence to provide a new definition for the symbol. For example, the participant must ignore the meaning of the words 'tot, tot', and 'bard, drab' so that he or she can see the rule for continuing the sequence: The first and last letters of the first stimulus in the pair are reversed in the second stimulus in the pair. In this way old familiar symbols are changed so that they have novel meaning.

EAS Symbolic Reasoning also utilizes unfamiliar symbols. In this case, however, participants are asked to learn new symbols and their meanings (i.e. logical operator symbols such as <, >, and =). They are then asked to perform the same abstract problem solving function as in EAS Verbal Reasoning. That is, a set of facts are presented using the logical operators and then a conclusion based on these facts is presented. The participant's task is to evaluate this conclusion and to determine if it is valid, invalid, or if it is impossible to determine its validity. While most individuals might have been exposed to such symbols at one time, they are not typically over-learned as are words.

Both SILS Abstraction and EAS Symbolic Reasoning require that participants perform cognitive tasks using unfamiliar or novel stimuli. Thus the task is made more difficult because the participant must remember the meaning of the symbol as well as the rules for completing the task successfully. Whatever resources an individual can apply to such a task must be divided between remembering what the new symbols mean and using them in solving the task. Put another way, before the problem can be solved, it must be translated into an understandable form. In contrast, the verbally based tests minimize the cognitive load because their stimuli require no translation.

The implication of such differences in task demands is this: Results from the present study could be seen as supporting some notion other than decreased sober abstract functioning caused by social drinking. A more parsimonious explanation might be that exposure to alcohol interferes with the ability to usefully integrate new information. The apparent effect on abstract functioning depends on the stimuli employed in such tests rather than the kind of cognitive function which is measured. In other words, drinking inhibits learning new associations, not abstract reasoning.

Seen from this perspective the results reported earlier make more sense. On those tests which used an already known method of presentation, practice effects were obvious. On

those tests where a hidden task requirement was to first re-learn the meanings of the symbols used, alcohol seemed to inhibit this and hence expected practice effects were less apparent.

This explanation goes some way toward making the observed results understandable, but it falls short of a complete explanation. There still remains the anomaly of unchanged performance by the Alcohol participants on EAS Verbal Reasoning while the Control participants showed a significant decline. As well, there is the unexpected improvement in SILS Vocabulary scores by the Alcohol group after greater than normal amounts of alcohol. The above suggestion, that exposure to alcohol inhibits the ability to usefully integrate novel information, does not apply here because the Alcohol participants were not exposed to novel information on these tasks.

Before attempting to address this issue further, one point should be clarified. It must be remembered that the Control group acts as the point of comparison for the study. They reflect what would have happened to the Alcohol group if these had not been exposed to alcohol. The temptation here is to attribute some change in the Controls' condition or experience with their decrease in performance. This is problematic because it ignores an underlying principle of controlled experimentation: Any explanation must account for changes in the performance of the experimental group, not for

changes in the control group. The deteriorative performance which the Control group displayed may have resulted from boredom, fatigue, or some other factor. The exact cause is not relevant. What is relevant is that the Alcohol group participants somehow avoided this.

The Alcohol group resisted deterioration in Verbal Reasoning when this should have occurred, and improved their Vocabulary performance when exposed to greater than normal amounts of alcohol. It is reasonable to attribute these effects to alcohol consumption because that was the only important distinction between the groups or sessions. It may be that the exposure to alcohol enhanced motivation and thereby produced better performances on these measures. Another explanation might be that alcohol inhibited memory processing in such a way that the repeated tasks seemed more novel at each testing session, and hence did not result in either boredom or lower scores like the Control participants. Or perhaps, more simply, exposure to alcohol enhanced the sober ability to utilize over-learned stimuli. Whatever the explanation might be, it is impossible to provide anything more than speculation at this point. A separate line of research investigating such apparent benefits of social drinking is warranted.

Theoretical Implications

In 1977 Parker and Noble first noted that there seemed to be a relationship between the amount of alcohol that an

individual drinks and that person's sober cognitive functioning. Over the next decade Parker and her colleagues reported a number of studies, each lending support to the notion that sober cognitive functioning is influenced by social drinking. In 1982 and again in 1985 Parker put forward a theoretical rationale for this. She suggested that the consumption of small amounts of alcohol causes transient changes in neuropsychological functioning. Without further exposure to alcohol, neuropsychological functioning returns to normal.

A similar model was put forward by Hill and Ryan (1985) and served as the theoretical rationale for the present study. They reviewed the research and concluded that there was little evidence to support the notion that social drinking produces permanent brain damage. They then postulated that, although there were no grounds to support a biological continuum of impairment resulting from alcohol consumption, there might be a behavioral continuum of impairment. They suggested that the physiological impact of alcohol consumption was different for social drinkers than for alcoholics. Both drinking patterns may result in observable changes in behaviour, but the process which produces these effects in the alcoholic is different from that of the social drinker. They proposed that the effects of alcohol evident in the alcoholic result from brain tissue damage. For the social drinker, the small changes in

neuropsychological functioning reported in the literature represent a transient phenomenon during which normal neuropsychological functioning is disrupted.

Hill's and Ryan's (1985) explanation implied a threshold phenomenon. Above some level of alcohol consumption tissue damage occurs and produces the typical neuropsychological deficits noted for alcoholism. Below this threshold the social drinker may experience some dose dependent, temporary decrements in cognitive functioning. The individual tolerance level of any social drinker, rather than some absolute amount of alcohol, determines the extent to which sober cognitive functioning is influenced. Put another way, for the social drinker the occurance of decrements in neuropsychological performance are limited to consumption levels which exceed individual tolerance, but which fall below the threshold necessary for neurophysiological changes to take place. Results from the present study can be placed in the context of Hill's and Ryan's predictions. It appears that on one measure of cognitive functioning, SILS Abstraction, Hill's and Ryan's predictions were born out. That is, when exposed to alcohol levels which exceeded their tolerance, participants seemed unable to benefit from practice. In contrast, if exposed to alcohol levels which did not exceed their tolerance, participants seemed able to utilize their experience and significantly improve their performance at the next opportunity.

Parker's work and the work by Hill and Ryan suggest that social drinking may interfere with sober cognitive functioning, particularly abstract functioning. Both suggest that such interference is non-pathological and different from the deteriorative effects of alcohol abuse. Results from the present study suggest an important extension of this explanation. Social drinking affects sober abstract functioning, but not by impairing abstract reasoning. Rather, the novel stimuli typically employed in tests of abstract functioning present the participant with two tasks; 1) learning the meaning of the novel stimuli, 2) performing the abstract task. Because participants did well on the verbally presented abstract reasoning task used here, the negative impact must be on their ability to cope with the novel stimuli.

One of the other implications of this finding is that to explain the impact of social drinking, one need not claim a global decrement in abstract functioning. If the observed results are attributable to difficulties in 'resource allocation', for lack of a better term, then fatigue, wandering concentration, or any number of other non-cortical related factors might account for how drinking affects thinking.

Thus, a new hypothesis which predicts a specific effect has been developed. Social drinking, or non-abusive drinking, above one's already established level of tolerance

will produce a relative decrease in sober performance on certain cognitive tasks. The type of task which will be most sensitive to the impact of social drinking is one which requires that stimuli with novel meaning be learned in order for the task to be successfully completed. Whether or not such tasks assess abstract functioning should be irrelevant.

A practical benefit of this hypothesis is that, because it does not make predictions about higher order brain functions, it can be tested by using an animal model. The increased control over alcohol exposure and tolerance make this one of the, if not the most, important implications of the present study.

Conclusions

The present study, employing a quasi-experimental design in which exposure to alcohol was manipulated, has provided evidence to support two conclusions. First, alcohol consumption at a level consistent with social drinking produces changes in sober cognitive functioning. This is supported by the finding that some verbally dependent tasks appear to be enhanced by exposure to alcohol. As well, sober performance on tasks requiring abstract functioning in problem solving appear to suffer following exposure to alcohol. Second, increased alcohol consumption above the level normally consumed also produces changes in sober cognitive functioning. This was apparent in enhanced

performance on a word recognition task, as well as in suppressed performance on a task of abstract reasoning.

The present study has provided support for the hypothesis that increased social drinking, beyond the usual level of consumption, results in decrements in abstract thinking as measured by SILS Abstraction. Sober cognitive functioning does seem to be affected by social drinking. The effect was subtle, was not apparent on a verbally based test of abstract functioning, and seemed to have a beneficial effect on some cognitive functions.

Although the conclusion about abstract thinking may be consistent with the observed results and hence valid, it is not useful in developing other testable hypotheses related to this phenomenon. Instead there is a more useful way of viewing these results. That is, these results are more parsimoniously explained by asserting that social drinking interferes with a different cognitive mechanism. Social drinking seems to interfere with the capacity to remember and apply novel information to a task. Thus, a new hypothesis arises and future research can test it by utilizing specific measures of this cognitive mechanism and comparing the impact of social drinking on these with the impact of social drinking on tests of abstract thinking which employ familiar symbols.

There are some immediate practical implications from these results as well. If the ability to integrate new

information is inhibited by social drinking, then some work related tasks could be enhanced by careful selection of the day these tasks are attempted. As well, there are obvious implications for adult education, job re-training programs, advertising strategies, and even psychotherapy. In terms of research in the area, each of these implications presents an opportunity for evaluating the hypothesis in a 'real world' setting.

One other very important research implication needs to be mentioned. Because the hypothesized cognitive mechanism is not necessarily unique to humans, animal studies could be conducted to test the hypothesis. Using an animal model has the advantage of allowing for tightly controlled access to alcohol at a level unacceptable in human research. This eliminates a serious potential confound which has caused concern to every researcher in the area.

The first step in this new research line is to re-conduct (rather than replicate) the present study with the following changes. First, a larger sample consisting of only males should be used. Second, the testing sessions should be supervised by a worker who has no other contact with the participants. Third, the Control group, like the Alcohol group, should be exposed to bi-weekly, Saturday night parties with cognitive testing taking place on the following Monday. These would all be 'dry' parties. By including these changes potential confounds could be controlled.

The present study is the first of its kind in the area because it addresses a causal hypothesis in an experimentally appropriate way. The methodology employed here is a significant improvement over earlier work in the area. The observed results are consistent with findings reported in other studies, but such consistency is not where the real merit of this study lies. The merit of the present work lies in its theoretical implications and in the new hypothesis which has been developed because of these implications. Future research in this area must continue to do the same if it is to be useful in understanding the sober impact of social drinking.

APPENDIX A

DSM-III CRITERIA FOR ALCOHOL DEPENDENCE AND ALCOHOL ABUSE

DSM III Criteria for Alcohol Dependence (303.90)

A. At least three of the following:

(1) substance often taken in larger amounts or over longer period than the person intended
(2) persistent desire or one or more unsuccessful efforts to cut down or control substance use
(3) a great deal of time spent in activities necessary to get the substance (e.g., theft), taking the substance, or recovering from its effects
(4) frequent intoxication or withdrawal symptoms when expected to fulfill major role obligations at work, school, or home, or when substance use is physically hazardous
(5) important social, occupational, or recreational activities given up or reduced because of substance use
(6) continued substance use despite knowledge of having a persistent or recurrent social, psychological, or physical problem that is caused or exacerbated by the use of the substance
(7) marked tolerance: need for markedly increased amounts of the substance (i.e., at least a 50% increase) in order to achieve intoxication or desired effect, or markedly diminished effect with continued use of the same amount
(8) characteristic withdrawal symptoms
(9) substance often taken to relieve or avoid withdrawal symptoms

B. Some symptoms of the disturbance have persisted for at least one month, or have occurred repeatedly over a longer period of time.

DSM III Criteria for Alcohol Abuse (305.00)

A. A maladaptive pattern of psychoactive substance use indicated by at least one of the following:

(1) continued use despite knowledge of having a persistent or recurrent social, occupational, psychological, or physical problem that is caused or exacerbated by use of the psychoactive substance
(2) recurrent use in situations in which use is physically hazardous (e.g., driving while intoxicated)

B. Some symptoms of the disturbance have persisted for at least one month, or have occurred repeatedly over a longer period of time.

C. Never met the criteria for Psychoactive Substance Dependence for this substance.

APPENDIX B

MEASURES TO BE USED

SILS VOCABULARY
Form II

Instructions: In the test below, the first word in each line is printed in capital letters. Opposite it are four other words. Circle the *one word* which means the *same thing*, or most nearly the same thing, as the first word. If you don't know, guess. Be sure to circle the *one word* in each line that means the same thing as the first word.

EXAMPLE:

	LARGE	red	big	silent	wet

1)	SOFA	pin	eraser	couch	glass
2)	FORGIVE	pardon	pound	divide	tell
3)	RECALL	milk	remember	number	ball
4)	SPEAK	draw	eat	talk	sleep
5)	ALLOW	permit	sew	cut	pay
6)	HEARTY	swift	muddy	leafy	cordial
7)	OBVIOUS	inert	evident	skeptical	afraid
8)	PRETENDER	conductor	fairy	book	impostor
9)	FALL	drink	dress	tumble	think
10)	DREADFUL	silvery	titled	bury	hideous
11)	ENCHANT	welcome	fix	sing	fascinate
12)	SIGNIFY	defy	excite	indicate	bicker
13)	STRENGTHEN	submerge	fortify	vent	deaden
14)	DESERVE	merit	distrust	unite	separate
15)	UNINFORMED	dull	sharp	ignorant	precise
16)	LARGE	bright	massive	speedy	surround
17)	TELL	yield	perceive	associate	narrate
18)	FAME	length	valour	renown	loyalty
19)	LAUGHTER	hilarity	irony	grace	malice
20)	SOILED	stolen	pointed	grown	smirched
21)	HELP	facilitate	inspire	join	bewilder
22)	HUMOROUS	jocose	paltry	fervid	prosaic
23)	HEADING	drum	ballast	caption	form
24)	INFORM	regret	strew	apprise	delight
25)	WASTE	tease	belittle	dump	squander
26)	CHARM	amulet	witch	dingo	rag
27)	RIGID	truth	level	inexorable	sparse
28)	DISPOSSESS	divest	intrude	haunt	pledge
29)	INHABITANT	senator	denizen	dwelling	relative
30)	LAMENT	chorus	rue	dominate	clothes
31)	MITIGATE	mollify	direct	pertain	change
32)	NOTCHED	streaked	serrated	stained	blunt
33)	APPROPRIATE	plagiarize	intend	revoke	maintain
34)	HOLE	den	orifice	building	complete
35)	SUPPLE	moldy	loose	lissome	convex
36)	OUTCAST	pariah	priest	outcrop	reel
37)	COMPLAINING	truculent	bitter	devout	querulous
38)	RASHNESS	temerity	timidity	dermatitis	knavery
39)	INCITE	arson	ensue	abet	placate
40)	FIRST	vain	acolyte	pristine	penultimate

SILS ABSTRACTION
Form II

Instructions: Complete the following by filling in either a number or a letter for each dash (___). Do the items in order, but don't spend too much time on any one item.

EXAMPLE: 1 2 3 4 ___

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1) A B C D E ___

2) light dark near far out ___ ___

3) 12 23 34 4 ___

4) 9 8 7 6 5 4 ___

5) A B C B A B C D C B C D E D C D E F ___ ___

6) NW / SE SW / NE S / N W / ___

7) relate elate late ___ ___ ___

8) on no bat tab loot ___ ___ ___ ___

9) A M B N C O D ___

10) bib bib ward draw 648 ___ ___ ___

11) just us risk is band an sing ___ ___

12) 68415 84156 41568 15684 ___ ___ ___ ___ ___

13) snap an before of assure us stir ___ ___

14) waterwheel wheelhouse housebound
___ ___ ___ ___ ___ ary

15) counter 1234567 ounce 23416 crone ___ ___ ___ ___ ___

16) his hit pal pan pet pew wan ___ ___ ___

17) measure yard garden breathes pants trousers
desire yen currency violin ___ ___ ___ ___ ___ ___
adjust

18) 4236 96 735 186 78 24___

19) tan ten bed bid sin son for ___ ___ ___

20) third i seventh h second e fourth ___

EAS SYMBOLIC REASONING

Form III

		T	F	?
1)	J > K = L, therefore, J = L	[ ]	[ ]	[ ]
2)	J > K > L, therefore, J > L	[ ]	[ ]	[ ]
3)	J < K < L, therefore, J > L	[ ]	[ ]	[ ]
4)	J > K = L, therefore, J > L	[ ]	[ ]	[ ]
5)	J > K < L, therefore, J < L	[ ]	[ ]	[ ]
6)	J = K = L, therefore, J = L	[ ]	[ ]	[ ]
7)	J < K = L, therefore, J = L	[ ]	[ ]	[ ]
8)	J < K > L, therefore, J > L	[ ]	[ ]	[ ]
9)	J > K > L, therefore, J > L	[ ]	[ ]	[ ]
10)	J = K > L, therefore, J > L	[ ]	[ ]	[ ]
11)	J < K > L, therefore, J > L	[ ]	[ ]	[ ]
12)	J > K = L, therefore, J = L	[ ]	[ ]	[ ]
13)	J = K < L, therefore, J > L	[ ]	[ ]	[ ]
14)	J > K < L, therefore, J < L	[ ]	[ ]	[ ]
15)	J < K > L, therefore, J < L	[ ]	[ ]	[ ]
16)	J < K = L, therefore, J = L	[ ]	[ ]	[ ]
17)	J > K < L, therefore, J < L	[ ]	[ ]	[ ]
18)	J > K < L, therefore, J > L	[ ]	[ ]	[ ]
19)	J > K < L, therefore, J < L	[ ]	[ ]	[ ]
20)	J > K < L, therefore, J > L	[ ]	[ ]	[ ]
21)	J < K < L, therefore, J < L	[ ]	[ ]	[ ]
22)	J > K < L, therefore, J < L	[ ]	[ ]	[ ]
23)	J > K > L, therefore, J > L	[ ]	[ ]	[ ]
24)	J < K > L, therefore, J < L	[ ]	[ ]	[ ]
25)	J > K < L, therefore, J < L	[ ]	[ ]	[ ]
26)	J > K > L, therefore, J > L	[ ]	[ ]	[ ]
27)	J > K < L, therefore, J = L	[ ]	[ ]	[ ]
28)	J > K < L, therefore, J = L	[ ]	[ ]	[ ]
29)	J < K < L, therefore, J < L	[ ]	[ ]	[ ]
30)	J < K < L, therefore, J < L	[ ]	[ ]	[ ]

EAS SYMBOLIC REASONING

Form IV

		T	F	?
1)	N = O < P, therefore, N = P	[ ]	[ ]	[ ]
2)	N < O < P, therefore, N < P	[ ]	[ ]	[ ]
3)	N = O > P, therefore, N = P	[ ]	[ ]	[ ]
4)	N < O = P, therefore, N < P	[ ]	[ ]	[ ]
5)	N = O < P, therefore, N < P	[ ]	[ ]	[ ]
6)	N > O > P, therefore, N < P	[ ]	[ ]	[ ]
7)	N = O = P, therefore, N = P	[ ]	[ ]	[ ]
8)	N < O > P, therefore, N < P	[ ]	[ ]	[ ]
9)	N < O < P, therefore, N < P	[ ]	[ ]	[ ]
10)	N > O < P, therefore, N > P	[ ]	[ ]	[ ]
11)	N < O > P, therefore, N > P	[ ]	[ ]	[ ]
12)	N < O = P, therefore, N = P	[ ]	[ ]	[ ]
13)	N > O < P, therefore, N < P	[ ]	[ ]	[ ]
14)	N < O > P, therefore, N > P	[ ]	[ ]	[ ]
15)	N = O > P, therefore, N < P	[ ]	[ ]	[ ]
16)	N < O > P, therefore, N = P	[ ]	[ ]	[ ]
17)	N < O > P, therefore, N = P	[ ]	[ ]	[ ]
18)	N < O > P, therefore, N < P	[ ]	[ ]	[ ]
19)	N < O < P, therefore, N < P	[ ]	[ ]	[ ]
20)	N > O > P, therefore, N > P	[ ]	[ ]	[ ]
21)	N < O > P, therefore, N > P	[ ]	[ ]	[ ]
22)	N > O < P, therefore, N < P	[ ]	[ ]	[ ]
23)	N > O < P, therefore, N > P	[ ]	[ ]	[ ]
24)	N < O > P, therefore, N < P	[ ]	[ ]	[ ]
25)	N > O = P, therefore, N = P	[ ]	[ ]	[ ]
26)	N < O > P, therefore, N > P	[ ]	[ ]	[ ]
27)	N > O > P, therefore, N > P	[ ]	[ ]	[ ]
28)	N > O < P, therefore, N > P	[ ]	[ ]	[ ]
29)	N < O < P, therefore, N < P	[ ]	[ ]	[ ]
30)	N > O > P, therefore, N > P	[ ]	[ ]	[ ]

EAS VERBAL REASONING
Form II

1)

FACTS Kansas does not tax personal income.
Montana and all its neighbors do tax personal income.
Montana is not a province.
Montana has a neighbor that is a province.

CONCLUSIONS

	T	F	X	
1)	[ ]	[ ]	[ ]	Kansas City does not tax personal income.
2)	[ ]	[ ]	[ ]	Kansas City is a personal income taxer.
3)	[ ]	[ ]	[ ]	All provinces are income taxers.
4)	[ ]	[ ]	[ ]	Some provinces are income taxers.
5)	[ ]	[ ]	[ ]	Kansas City is a province.

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2)

FACTS Everyone on the first floor reports to Mr. Wand.
Jack has no accounts.
John is Mr. Wand's subordinant.
Paul is on the first floor.
Mr. Wand has employees in the basement.

CONCLUSIONS

	T	F	X	
1)	[ ]	[ ]	[ ]	Jack is on the first floor.
2)	[ ]	[ ]	[ ]	Paul reports to Mr. Wand.
3)	[ ]	[ ]	[ ]	John is on the first floor.
4)	[ ]	[ ]	[ ]	Jack is not on the first floor.
5)	[ ]	[ ]	[ ]	Mr. Wand is on the first floor.

BAS VERBAL REASONING
Form II Cont'd

3)

FACTS All seasons tickets in section 'A' are box seats.
Hal has box seat seasons tickets.
Peter does not have bleacher seats.
Jake's box seats are in section 'A'.
All seasons tickets seats in section 'A' are padded.

CONCLUSIONS

	T	F	X	
1)	[ ]	[ ]	[ ]	Jake sits on a padded seat.
2)	[ ]	[ ]	[ ]	Peter sits in a heated seat.
3)	[ ]	[ ]	[ ]	Hal sits in section 'A'.
4)	[ ]	[ ]	[ ]	Jake is a Blue Jay fan.
5)	[ ]	[ ]	[ ]	Jake has box seat seasons tickets.

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4)

FACTS All vehicles on King Street are cars.
Some of Tom's vehicles are on Queen Street.
Philip owns a truck.
Every vehicle Beth owns is on King Street.

CONCLUSIONS

	T	F	X	
1)	[ ]	[ ]	[ ]	Some of Tom's vehicles are on King St.
2)	[ ]	[ ]	[ ]	Tom has no vehicles on King St.
3)	[ ]	[ ]	[ ]	Beth owns no cars.
4)	[ ]	[ ]	[ ]	Philip has no vehicles on King St.
5)	[ ]	[ ]	[ ]	Beth owns no trucks.

EAS VERBAL REASONING
Form II Cont'd

5)

FACTS Antiques are older than classics.
Classics are younger than heirlooms.
Heirlooms are older than collectibles.
Classics are the same age as relics.

CONCLUSIONS

	T	F	X	
1)	[ ]	[ ]	[ ]	Relics are older than antiques.
2)	[ ]	[ ]	[ ]	Antiques and collectibles are the same age.
3)	[ ]	[ ]	[ ]	Antiques are younger than heirlooms.
4)	[ ]	[ ]	[ ]	Relics are older than collectibles.
5)	[ ]	[ ]	[ ]	Collectibles are younger than relics.

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6)

FACTS Lake Bluewater is deeper than Red River.
Sunset Lake is not shallower than Cloudy Lake.
Red River is shallower than Yellow River.
Yellow River is not deeper than Cloudy Lake.

CONCLUSIONS

	T	F	X	
1)	[ ]	[ ]	[ ]	Yellow River is not deeper than Lake Bluewater.
2)	[ ]	[ ]	[ ]	Red River is not shallower than Sunset Lake.
3)	[ ]	[ ]	[ ]	Cloudy Lake is not the same depth as Lake Bluewater.
4)	[ ]	[ ]	[ ]	Red River is not deeper than Cloudy Lake.
5)	[ ]	[ ]	[ ]	Yellow River is shallower than Cloudy Lake.

EAS VERBAL REASONING
Form III

1)

FACTS Katherine does not ski.
Elizabeth and all of her co-workers do ski.
Elizabeth is not a computer programer.
Elizabeth has a co-worker who is a computer programer.

CONCLUSIONS

	T	F	X	
1)	[ ]	[ ]	[ ]	Kathleen does not ski.
2)	[ ]	[ ]	[ ]	Kathleen is a skier.
3)	[ ]	[ ]	[ ]	All computer programers ski.
4)	[ ]	[ ]	[ ]	Some computer programers ski.
5)	[ ]	[ ]	[ ]	Kathleen is a computer programer.

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2)

FACTS Every computer in the tax department can use IBM software.
The 'Audit' program has no warranty.
The 'Tax Report' program is an IBM software product.
The Spreadsheet computer is in the tax department.
IBM software has a service department.

CONCLUSIONS

	T	F	X	
1)	[ ]	[ ]	[ ]	The 'Audit' program is in the tax dept.
2)	[ ]	[ ]	[ ]	The Spreadsheet computer can use IBM software.
3)	[ ]	[ ]	[ ]	The 'Tax Report' program is in the tax dept.
4)	[ ]	[ ]	[ ]	The 'Audit' program is not in the tax dept.
5)	[ ]	[ ]	[ ]	IBM software is in the tax dept.

EAS VERBAL REASONING
Form III Cont'd

3)

FACTS All cars in parking level 2 are leased.
Tilden has leased cars.
Hertz does not rent boats.
Avis parks in parking level 2.
All cars in parking level 2 are in rented spots.

CONCLUSIONS

	T	F	X	
1)	[ ]	[ ]	[ ]	Avis parks in rented spots.
2)	[ ]	[ ]	[ ]	Hertz parks in an underground lot.
3)	[ ]	[ ]	[ ]	Tilden parks in parking level 2.
4)	[ ]	[ ]	[ ]	Avis is a truck renter.
5)	[ ]	[ ]	[ ]	Avis has leased cars.

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4)

FACTS All factories in Canada are manufacturing plants.
Some of Zip Inc.'s factories are in Australia.
Tools Ltd. owns an assembly plant.
Every factory Toy Co. owns is in Canada.
Most of Zip Inc.'s factories are assembly plants.

CONCLUSIONS

	T	F	X	
1)	[ ]	[ ]	[ ]	Some of Zip Inc.'s factories are in Canada.
2)	[ ]	[ ]	[ ]	Zip Inc. has no factories in Canada.
3)	[ ]	[ ]	[ ]	Toy Co. owns no manufacturing plants.
4)	[ ]	[ ]	[ ]	Tools Ltd. has no factories in Canada.
5)	[ ]	[ ]	[ ]	Toy Co. owns no assembly plants.

EAS VERBAL REASONING
Form III Cont'd

5)
FACTS City A is further than City B.
City B is nearer than City C.
City C is further than City D.
City B is the same distance as City E.

CONCLUSIONS

	T	F	X	
1)	[ ]	[ ]	[ ]	City E is further than City A.
2)	[ ]	[ ]	[ ]	City A and City D are the same distance.
3)	[ ]	[ ]	[ ]	City A is nearer than City C.
4)	[ ]	[ ]	[ ]	City E is further than City D.
5)	[ ]	[ ]	[ ]	City D is nearer than City E.

---

6)
FACTS The community centre is bigger than the bank.
The restaurant is not smaller than the clinic.
The bank is smaller than the theatre.
The theatre is not bigger than the clinic.

CONCLUSIONS

	T	F	X	
1)	[ ]	[ ]	[ ]	The theatre is not bigger than the community centre.
2)	[ ]	[ ]	[ ]	The bank is not smaller than the restaurant.
3)	[ ]	[ ]	[ ]	The clinic is not the same size as the community centre.
4)	[ ]	[ ]	[ ]	The bank is not bigger than the clinic.
5)	[ ]	[ ]	[ ]	The theatre is smaller than the clinic.

EAS VERBAL REASONING
Form IV

1)

FACTS Apex Co. does not manufacture goods.
Aldo Co. and all its subsidiaries do manufacture goods.
Aldo Co. is not a widget assembler.
Aldo Co. has a subsidiary which is a widget assembler.

CONCLUSIONS

	T	F	X	
1)	[ ]	[ ]	[ ]	Ajax Co. does not manufacture goods.
2)	[ ]	[ ]	[ ]	Ajax Co. manufacturers goods.
3)	[ ]	[ ]	[ ]	All widget assemblers manufacture goods.
4)	[ ]	[ ]	[ ]	Some widget assemblers manufacture goods.
5)	[ ]	[ ]	[ ]	Ajax Co. is a widget assembler.

---

2)

FACTS Every horse on the ranch is related to Northern Dancer.
Secretariat has no offspring.
The stallion Spots is Northern Dancer's sibling.
The colt Silver is on the ranch.
Northern Dancer has a son in Kentucky.

CONCLUSIONS

	T	F	X	
1)	[ ]	[ ]	[ ]	Secretariat is on the ranch.
2)	[ ]	[ ]	[ ]	The colt Silver is related to Northern Dancer.
3)	[ ]	[ ]	[ ]	The stallion Spots is on the ranch.
4)	[ ]	[ ]	[ ]	Secretariat is not on the ranch.
5)	[ ]	[ ]	[ ]	Northern Dancer is on the ranch.

EAS VERBAL REASONING
Form IV Cont'd

3)

FACTS All towns in Alberta are growing.
Town A is a growing town.
Town B is not a city.
Town C is in Alberta.
All towns in Alberta are pretty.

CONCLUSIONS

	T	F	X	
1)	[ ]	[ ]	[ ]	Town C is a pretty town.
2)	[ ]	[ ]	[ ]	Town B is in a ravine.
3)	[ ]	[ ]	[ ]	Town A is in Alberta.
4)	[ ]	[ ]	[ ]	Town C is near the border.
5)	[ ]	[ ]	[ ]	Town C is a growing town.

---

4)

FACTS All orbiting satellites around planet A are artificial satellites.
Some of solar system 1's orbiting satellites are around planet B.
Solar system 2 owns a natural satellite.
Every orbiting satellite that solar system 3 owns is around planet A.
Most of solar system 1's orbiting satellites are natural satellites.

CONCLUSIONS

	T	F	X	
1)	[ ]	[ ]	[ ]	Some of solar system 1's orbiting satellites are around planet A.
2)	[ ]	[ ]	[ ]	Solar system 1 has no orbiting satellites around planet A.
3)	[ ]	[ ]	[ ]	Solar system 3 owns no artificial satellites.
4)	[ ]	[ ]	[ ]	Solar system 2 has no orbiting satellites around planet A.
5)	[ ]	[ ]	[ ]	Solar system 3 owns no natural satellites.

EAS VERBAL REASONING
Form IV Cont'd

5)

FACTS Sam is taller than Tony.
Tony is shorter than Alex.
Alex is taller than Carl.
Tony is the same height as Jim.

CONCLUSIONS

	T	F	X	
1)	[ ]	[ ]	[ ]	Jim is taller than Sam.
2)	[ ]	[ ]	[ ]	Sam and Carl are the same height.
3)	[ ]	[ ]	[ ]	Sam is shorter than Alex.
4)	[ ]	[ ]	[ ]	Jim is taller than Carl.
5)	[ ]	[ ]	[ ]	Carl is shorter than Jim.

---

6)

FACTS The red ribbon is wider than the blue ribbon.
The green ribbon is not narrower than the gold ribbon.
The blue ribbon is narrower than the yellow ribbon.
The yellow ribbon is not wider than the gold ribbon.

CONCLUSIONS

	T	F	X	
1)	[ ]	[ ]	[ ]	The yellow ribbon is not wider than the red ribbon.
2)	[ ]	[ ]	[ ]	The blue ribbon is not narrower than the green ribbon.
3)	[ ]	[ ]	[ ]	The gold ribbon is not the same width as the red ribbon.
4)	[ ]	[ ]	[ ]	The blue ribbon is not wider than the gold ribbon.
5)	[ ]	[ ]	[ ]	The yellow ribbon is narrower than the gold ribbon.

Questionnaire

1) DATE OF BIRTH:

Yr Mn D
___/___/___

2) PARTICIPANT NUMBER:

___ ___ ___ ___

3) SEX: FEMALE ____ MALE ____

4) WHAT IS THE HIGHEST LEVEL OF EDUCATION YOU HAVE COMPLETED? (mark one)

GRADUATE PROFESSIONAL TRAINING WITH DEGREE	____
COLLEGE OR UNIVERSITY GRADUATION	____
PARTIAL COLLEGE OR UNIVERSITY TRAINING	____
HIGH-SCHOOL GRADUATION	____
PARTIAL HIGH-SCHOOL, GRADES 10-13	____
PARTIAL HIGH-SCHOOL, GRADES 9 AND 10	____
LESS THAN 8 YEARS OF SCHOOL	____

5) WHAT IS YOUR OCCUPATION? (if you are a student please indicate the occupation of the primary income earner in your nuclear family)

GENERAL LABOUR, UNSKILLED WORK	____
SEMI-SKILLED WORK	____
SKILLED TRADE (e.g. carpenter, plumber, etc.)	____
OWNER OF SMALL BUSINESS, SALESMAN, TECHNICIAN	____
ADMINISTRATOR OF LARGE BUSINESS, SEMI-PROFESSIONAL	____
MANAGER OR PROPRIETOR OF MEDIUM-SIZED BUSINESS	____
EXECUTIVE OR OWNER OF LARGE BUSINESS, PROFESSIONAL (e.g. teacher, lawyer, physician, etc)	____

6) WHAT IS YOUR USUAL BODY WEIGHT? _____ POUNDS.

7) THINKING BACK, HOW OLD WERE YOU WHEN YOU FIRST DRANK ENOUGH TO FEEL INTOXICATED?

_____ YEARS OLD.

8) DURING A TYPICAL WEEK, HOW FREQUENTLY DO YOU DRINK ALCOHOL? (mark one)

DAILY	___
SIX DAYS PER WEEK	___
FIVE DAYS PER WEEK	___
FOUR DAYS PER WEEK	___
THREE DAYS PER WEEK	___
TWO DAYS PER WEEK	___
ONE DAY PER WEEK	___
LESS THAN ONCE PER WEEK	___
I DO NOT DRINK	___

9) OVER THE PAST SIX MONTHS, WHAT WAS THE MAXIMUM NUMBER OF DAYS IN A ROW THAT YOU DRANK ALCOHOL?

SPECIFY NUMBER OF DAYS IN A ROW ____
(If you cannot be specific, please mark one of the options below)

DRANK EVERY DAY ___
15 DAYS OR MORE IN A ROW ___
8 - 14 DAYS IN A ROW ___
3 - 7 DAYS IN A ROW ___
1 - 2 DAYS IN A ROW ___

1 STANDARD DRINK = 12 OZ. BEER

5 OZ. TABLE WINE

3.5 OZ. FORTIFIED WINE

1.5 OZ. SPIRITS

10) IN THE PAST SIX MONTHS, WHAT IS THE MAXIMUM YOU HAVE HAD TO DRINK ON ANY ONE DAY?

____ STANDARD DRINKS

11) IN THE PAST SIX MONTHS, HOW MANY DAYS HAVE YOU HAD YOUR MAXIMUM NUMBER OF DRINKS?

____ DAYS

12) ON THOSE OCCASIONS WHEN YOU DO DRINK, HOW MUCH DO YOU UEUALLY CONSUME?

____ STANDARD DRINKS

13) HAVE YOU EVER RECEIVED A HEAD INJURY WHICH CAUSED YOU TO LOOSE CONSCIOUSNESS?

___ YES ___ NO

14) CURRENTLY, HOW OFTEN DO YOU USE ANY OF THE FOLLOWING?

	NOT AT ALL	A FEW TIMES	EACH MONTH	EACH WEEK	EACH DAY
a) MEDICATION PRESCRIBED BY A DOCTOR	1	2	3	4	5
b) STRONG PAIN RELIEVERS (e.g. DEMEROL)	1	2	3	4	5
c) COUGH OR COLD REMEDIES (e.g. ANTIHISTAMINES)	1	2	3	4	5
d) TRANQUILIZERS (e.g. LIBRIUM, VALIUM)	1	2	3	4	5
e) BARBITURATES (e.g. SECONAL, AMYTAL)	1	2	3	4	5
f) STIMULANTS (e.g. DIET PILLS, AMPHETAMINES, SPEED)	1	2	3	4	5
g) CANNABIS (e.g. MARIJUANA, HASHISH)	1	2	3	4	5
h) COCAINE	1	2	3	4	5
i) HEROIN	1	2	3	4	5
j) HALLUCINOGENS (e.g. LSD, PCP, ACID)	1	2	3	4	5
k) PAIN RELIEVERS (e.g. ASPIRIN, TYLENOL)	1	2	3	4	5

15) HAVE YOU EVER BEEN TREATED FOR THE FOLLOWING?

	YES	NO
EPILEPSY	___	___
LIVER DISORDERS	___	___
HEART DISEASE	___	___

16) DO YOU CURRENTLY EXPERIENCE ANY OF THE FOLLOWING?

	YES	NO
FAINTING SPELLS	___	___
SEVERE HEADACHES	___	___
SEIZURES	___	___
MEMORY LOSS	___	___
DIZZINESS	___	___
CLUMSINESS	___	___
TREMORS (SHAKES)	___	___

17) WHICH OF THE FOLLOWING INDIVIDUALS, IF ANY, CURRENTLY EXPERIENCE, OR HAVE EXPERIENCED, PROBLEMS WITH THEIR CONSUMPTION OF ALCOHOL?

	YES	NO
FATHER	___	___
MOTHER	___	___
SISTER	___	___
BROTHER	___	___

THANK-YOU FOR COMPLETING THIS QUESTIONNAIRE.

CALENDAR CUED DRINKING HISTORY

The purpose of this task is to determine both the pattern and the amount of alcohol you have consumed in the past month. To help you be as accurate as possible we have presented a calendar below. Please indicate the number of standard drinks you consumed on each day by filling in the appropriate square. Begin with yesterday and continue until you have filled in the squares for the past 28 days. It may be useful to identify memorable events (e.g. parties, a weekend trip) and fill in those days first. Be sure to count drinks that you may have had with meals. Remember, be as accurate as possible when filling in the calendar.

One standard drink = 12 oz. beer (one bottle)
5 oz. wine
3.5 oz. fortified wine (e.g.sherry)
1.5 oz. spirits (e.g. gin, liqueur)

FEBRUARY

Sun	Mon	Tue	Wed	Thurs	Fri	Sat
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29					

MARCH

Sun	Mon	Tues	Wed	Thurs	Fri	Sat
		1	2	3	4	5
6	7					

Self-report Measure of Alcohol Consumption

In the spaces provided below, please indicate how many standard drinks you consumed on the indicated days. Thank you.

TODAY (Monday) _____

YESTERDAY (Sunday) _____

LAST SATURDAY _____

LAST FRIDAY _____

APPENDIX C
CONSENT FORMS

PARTICIPANT CONSENT FORM

Name _____ Date _____

_____

I, _____ hereby consent to participate in a study investigating the effects of alcohol consumption on sober functioning. The purpose and procedures of this project have been explained to me. I understand that:

1) The purpose of the study is to examine the effects of alcohol consumption on my sober functioning;

2) I will be required to abstain from the consumption of alcohol for periods of up to three days as a result of my participation;

3) I will be placed in a situation where I can consume alcohol only up to a pre-determined limit set by the experimenter;

4) Participation will require my attendance at one session where general information about me and about my drinking practices will be sought;

5) Participation will require my attendance at four evening sessions, two of which will have alcohol available and two of which will supply no alcohol;

6) Participation will require my attendance at four day-time testing sessions;

7) I understand that this study does not require me to drink any amount of alcohol and that the consumption of alcohol will be a voluntary choice on my part;

8) I agree to abide by the rules of conduct set out by the experimenter or his representatives insofar as this does not conflict with my right to withdraw from the study;

9) I may withdraw from the study at any time, in which event I may request that data obtained from me will not be included in the analyses of the results of the study with the exception of data concerning withdrawal from the study;

10) Upon my request, I will be provided with a full description of the findings when the entire study is completed;

11) I will be required to complete a questionnaire which elicits information concerning my alcohol consumption, age, body weight, income category, education, physical health, and drug use;

12) I will be required to complete a procedure which is designed to elicit information concerning my recent alcohol consumption;

13) I will be required to complete a series of tasks designed to assess my cognitive abilities;

14) I will receive no financial remuneration for participating in the study;

15) Any information gathered from me during the entire course of this study will be entirely confidential. I hereby authorize the use of all data derived from the study for research purposes, presentation at scientific meetings and publication in scientific journals or books, provided that there is no disclosure in any way of my identity;

I understand fully and consent to the procedures of this study.

Dated this _____ day of _____, 1987.

_____
Signature of Participant

Investigators: Keith A. McFarlane, M.A.
J. Cohen, Ph.D

CONSENT FORM

DATE: _____

I, _____ hereby agree to abide by the rules of behaviour set out by the experimenter or his assistants. I agree to remain at this study site for at least one hour after my last alcoholic drink before leaving. I also agree to remain on these premises until a study assistant can escort me home. Should I leave early or without such an escort I waive any claim, or right to claim, for liability against all persons or institutions connected with this study.

_____ _____

Signature of Participant Date

_____ _____

Witness Date

Dear Physician:

The bearer of this letter has agreed to participate in a research project investigating the impact of social drinking on sober cognitive functioning. This research has been approved by the university of Windsor and represents the research component of my Doctoral Thesis in Psychology. However, because participants will be allowed access to alcoholic beverages, the University has requested that a medical consent for each participant be obtained.

The study requests participants' attendance at four Saturday night gatherings (8:00 p.m. to 1:00 a.m.). At two of these no alcohol will be available to participants. At one Saturday night gathering participants will have access to alcohol, but only up to their individually calculated mean consumption level (based on consumption levels for a baseline period of 28 days). At a second 'alcohol available' gathering, participants will have access to an increase of 33% over their individually calculated mean alcohol consumption level. While this may seem like a large increase in potential consumption, there are a number of safeguards built into the study to minimize this.

First, this increase represents an upper cutoff, or ceiling, for the number of standard drinks a participant can receive; it does not define any minimum consumption level. Participants will be able to drink any amount less than their upper limit if they so choose. As well, no one assisting with the study will 'push' drinks.

Second, the increase in available alcohol to the individual participant will never exceed the maximum amount which that individual reported consuming in the previous six months. That is, participants will not have access to more alcohol than they have already chosen to consume.

Third, an arbitrary cutoff level will be applied to any participant who's mean consumption and maximum consumption levels suggest an experimental ceiling of more than eight standard drinks. That is, no participant will be allowed access to more than eight standard drinks over the course of the evening.

Fourth, abstinent volunteers (graduate students) will be present at all times to supervise the proceedings. As well, at the conclusion of each gathering these volunteers will drive participants home.

Fifth, at midnight on the night of these gatherings no more alcohol will be available to any participant.

Given the experimental conditions and safeguards described above, I would appreciate your granting to this individual, if appropriate, medical consent to participate in this research project. Should you have any questions you can reach me or my thesis supervisor (Dr. J. Cohen) through the Psychology Department at the University of Windsor (253-4232, X-2218). Thank you for your consideration in this matter.

Sincerely,

Keith A. McFarlane, M.A.

_____ is _____ fit
(participant's name)
_____ unfit

to participate in the Social Drinking Research Project.

_____
(Physician's signature)

_____
(Date)

APPENDIX D

CHARACTERISTICS OF THE SAMPLE:

DEMOGRAPHIC, COGNITIVE, AND ALCOHOL CONSUMPTION MEASURES

Table 8

Demographic Characteristics of the Sample:

Control Group, Alcohol Group and Total Sample

	Control Group (n=18)	Alcohol Group (n=18)	Total Sample (N=36)
Gender			
Male	6	13	19
Female	12	5	17
Education			
Partial college or university	16	18	34
University or college grad	2	0	2
Hollingshead Two Factor Index of Social Class			
I	0	0	0
II	3	3	6
III	6	7	13
IV	2	3	5
V	6	5	11
missing	1	0	1

	Mean	SD	Mean	SD	Mean	SD
Age (years)	20.89	2.91	21.06	4.19	20.97	3.56
Weight (pounds)	144.2	25.5	159.6	24.6	151.9	25.9

Table 9

Baseline Characteristics by Gender

Measure	Female (N=17)		Male (N=19)	
	Mean	SD	Mean	SD
Age	21.59	4.90	20.42	1.61
Weight	132.71	20.22	169.05	16.79
Frequency of Consumption[2] (CCDH)	6.59	3.12	6.68	3.97
Number of Drinks Consumed[1] (CCDH)	22.79	14.13	31.53	22.42
Mean QPO[1] (CCDH)	3.41	1.50	4.34	2.01
Self Report Average QPO[1] (Questionnaire)	4.12	2.23	5.53	2.14
Maximum Daily Consumption[1], Past Six Months (Questionnaire)	9.47	3.68	11.32	5.58
Frequency of Days at Maximum[3] (Questionnaire)	5.59	8.42	3.95	4.61
State Anxiety	37.94	10.00	41.00	9.74
EAS Symbolic Reasoning	10.18	5.21	10.58	5.44
EAS Verbal Reasoning	16.77	3.53	13.95	4.38
SILS Abstraction	35.06	3.01	32.63	4.06
SILS Vocabulary	28.47	3.50	30.26	4.81

[1] Reported in standard drink units
[2] Reported as number of days
[3] Reported as number of days in the past 6 months

Table 10

Means and Standard Deviations for Alcohol Consumption Measures; Calender Cued Drinking History and Questionnaire Items

Measure	Control Group (n=18)		Alcohol Group (n=18)		Total Sample (N=36)	
	Mean	SD	Mean	SD	Mean	SD
Frequency of Consumption[2] (CCDH)	6.39	3.91	6.89	3.23	6.64	3.55
Number of Drinks Consumed[1] (CCDH)	20.58	14.60	34.22	21.18	27.4	19.22
Mean QPD[1] (CCDH)	3.17	1.46	4.63	1.90	3.90	1.83
Self Report Average QPD[1] (Questionnaire)	4.28	2.08	5.44	2.36	4.86	2.27
Maximum Daily Consumption[1], Past Six Months (Questionnaire)	9.44	4.09	11.44	5.35	10.44	4.80
Frequency of Days at Maximum[3] (Questionnaire)	5.33	8.21	4.11	4.74	4.72	6.64

[1] Reported in standard drink units
[2] Reported as number of days
[3] Reported as number of days in the past 6 months

Table 11

Means and Standard Deviations of Cognitive Measures at Baseline: Control Group and Alcohol Group

Test Session	Test	Control Group (n=18)		Alcohol Group (n=18)	
		Mean	SD	Mean	SD
Session One	SILS Vocabulary	28.28	4.28	30.56	4.08
	SILS Abstraction	33.56	4.09	34.00	3.50
	EAS Verbal Reasoning	16.33	4.26	14.22	3.96
	EAS Symbolic Reasoning	11.39	5.81	9.39	4.59
Session Three	SILS Vocabulary	30.11	4.13	33.22	3.08
	SILS Abstraction	35.89	3.18	36.22	4.85
	EAS Verbal Reasoning	14.83	5.61	13.44	4.66
	EAS Symbolic Reasoning	12.67	6.64	12.39	6.89

Table 12

Means and Standard Deviations of Dependent Measures: Control Group, Alcohol Group, and Total Sample

	EAS Symbolic Reasoning							
Group	Session 1		Session 2		Session 3		Session 4	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Control	11.39	5.81	11.28	5.36	12.67	6.64	14.94	6.80
Alcohol	9.39	4.59	9.00	3.80	12.39	6.89	11.78	4.95
Total	10.39	5.26	10.14	4.72	12.53	6.67	13.36	6.08

	EAS Verbal Reasoning							
Group	Session 1		Session 2		Session 3		Session 4	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Control	16.33	4.26	13.89	5.47	14.83	5.61	12.44	5.44
Alcohol	14.22	3.96	14.68	3.79	13.44	4.66	14.78	3.59
Total	15.28	4.19	14.28	4.65	14.14	5.13	13.61	4.69

	Shipley's Abstraction							
Group	Session 1		Session 2		Session 3		Session 4	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Control	33.56	4.09	34.67	3.76	35.89	3.18	36.11	2.52
Alcohol	34.00	3.50	33.89	4.97	36.22	4.85	35.44	4.22
Total	33.78	3.76	34.28	4.36	36.06	4.04	35.78	3.44

(Table Continues)

Table 12 (continued)

Means and Standard Deviations of Dependent Measures: Control Group, Alcohol Group, and Total Sample

	Shipley's Vocabulary							
Group	Session 1		Session 2		Session 3		Session 4	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Control	28.28	4.28	30.72	5.15	30.11	4.13	32.06	5.18
Alcohol	30.56	4.08	33.44	3.54	33.22	3.08	34.17	3.20
Total	29.42	4.28	32.08	4.57	31.67	3.92	33.11	4.35

Table 13

Means and Standard Deviations of Dependent Measures: Alcohol sub-Groups

	EAS Symbolic Reasoning							
Group	Session 1		Session 2		Session 3		Session 4	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Session 2 Increase (n=6)	9.67	5.09	7.83	3.06	9.33	5.79	9.00	3.74
Session 4 Increase (n=8)	10.00	4.96	10.75	3.92	14.25	6.54	14.63	3.62

	EAS Verbal Reasoning							
Group	Session 1		Session 2		Session 3		Session 4	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Session 2 Increase (n=6)	11.50	3.02	13.50	3.02	11.83	2.79	12.33	2.66
Session 4 Increase (n=8)	14.88	3.72	16.00	3.16	14.00	5.58	16.25	3.54

(table continues)

Table 13 (Continued)

Means and Standard Deviations of Dependent Measures; Alcohol sub-Groups

	Shipley's Abstraction							
Group	Session 1		Session 2		Session 3		Session 4	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Session 2 Increase (n=6)	31.67	4.46	32.00	7.27	33.67	7.42	33.33	6.41
Session 4 Increase (n=8)	35.25	2.61	35.00	2.14	38.00	2.14	34.63	3.74

	Shipley's Vocabulary							
Group	Session 1		Session 2		Session 3		Session 4	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Session 2 Increase (n=6)	28.83	4.79	33.67	3.14	33.33	1.97	33.83	2.48
Session 4 Increase (n=8)	31.75	3.96	33.75	3.92	33.38	3.96	34.63	3.74

APPENDIX E

F VALUES FOR ALL ANALYSES

Table 14

Obtained F Values for All Mancova Analyses Conducted

Source	First Analysis			
	Wilks' Value	DF	Exact F	Probability Level
Group by Gender	.88128	4, 27	.9094	.473
Gender	.77304	4, 27	1.9818	.126
Group	.79670	4, 27	1.7224	.174
Group by Gender by Set	.79636	4, 28	1.7900	.159
Gender by Set	.95869	4, 28	.3016	.874
Group by Set	.92280	4, 28	.5043	.733
Set	.20268	4, 28	27.537	.000
Group by Gender by Time	.83138	4, 28	1.4198	.253
Gender by Time	.80033	4, 28	1.7464	.168
Group by Time	.50737	4, 28	6.7966	.001
Time	.60682	4, 28	4.5355	.006
Group by Gender by Set by Time	.81530	4, 28	1.5858	.206
Gender by Set by Time	.91135	4, 28	.6810	.611
Group by Set by Time	.86482	4, 28	1.0941	.379
Set by Time	.85194	4, 28	1.2165	.326

(table continues)

Table 14 (Continued)

Obtained F Values for All Mancova Analyses Conducted

	Second Analysis:			
Source	Wilks' Value	DF	Exact F	Probability Level
Group	.15366	4, 4	5.5080	.064
Group by Set	.66532	4, 5	.6289	.663
Set	.08396	4, 5	13.6377	.007
Group by Time	.12686	4, 5	8.6035	.018
Time	.03119	4, 5	38.8324	.001
Group by Set by Time	.30310	4, 5	2.8740	.139
Set by Time	.25755	4, 5	3.6034	.096

Table 15

Supplementary ANCOVAs for All Analyses

First Analysis

EAS Symbolic Reasoning

Source	DF	F	Significance
Group by Gender	1, 30	1.67	.206
Gender	1, 30	.09	.762
Group	1, 30	.56	.460
Group by Gender by Set	1, 31	1.26	.270
Gender by Set	1, 31	.00	.985
Group by Set	1, 31	.06	.807
Set	1, 31	12.99	.001
Group by Gender by Time	1, 31	.32	.578
Gender by Time	1, 31	1.17	.288
Group by Time	1, 31	.59	.448
Time	1, 31	.71	.404
Group by Gender by Set by Time	1, 31	1.17	.288
Gender by Set by Time	1, 31	1.15	.292
Group by Set by Time	1, 31	2.67	.112
Set by Time	1, 31	.43	.517

EAS Verbal Reasoning

Source	DF	F	Significance
Group by Gender	1, 30	1.29	.266
Gender	1, 30	2.68	.112
Group	1, 30	.08	.785
Group by Gender by Set	1, 31	.74	.398
Gender by Set	31	.00	.984
Group by Set	1, 31	1.61	.214
Set	1, 31	3.76	.062
Group by Gender by Time	1, 31	.03	.856
Gender by Time	1, 31	.33	.572
Group by Time	1, 31	9.19	.005
Time	1, 31	2.07	.161
Group by Gender by Set by Time	1, 31	.10	.757
Gender by Set by Time	1, 31	.76	.391
Group by Set by Time	1, 31	.00	.999
Set by Time	1, 31	.19	.668

Table 15 (Continued)

Supplementary ANCOVAs for All Analyses

First Analysis

SILS Abstraction, Total Sample

Source	DF	F	Significance
Group by Gender	1, 30	.00	.974
Gender	1, 30	1.71	.202
Group	1, 30	.31	.583
Group by Gender by Set	1, 31	.52	.475
Gender by Set	1, 31	.80	.378
Group by Set	1, 31	.10	.758
Set	1, 31	29.60	.000
Group by Gender by Time	1, 31	3.58	.068
Gender by Time	1, 31	4.19	.049
Group by Time	1, 31	3.92	.057
Time	1, 31	.99	.327
Group by Gender by Set by Time	1, 31	3.82	.060
Gender by Set by Time	1, 31	.03	.868
Group by Set by Time	1, 31	.01	.937
Set by Time	1, 31	2.29	.140

First Analysis

SILS Abstraction, Females

Source	DF	F	Significance
Group	1, 13	.39	.544
Group by Set	1, 14	.02	.884
Set	1, 14	5.48	.035
Group by Time	1, 14	.16	.694
Time	1, 14	1.06	.321
Group by Set by Time	1, 14	2.40	.144
Set by Time	1, 14	1.49	.242

(Table Continues)

Table 15 (Continued)

Supplementary ANCOVAs for All Analyses

First Analysis

SILS Abstraction, Males

Source	DF	F	Significance
Group	1, 15	.28	.602
Group by Set	1, 16	1.19	.291
Set	1, 16	52.68	.000
Group by Time	1, 16	6.60	.021
Time	1, 16	4.57	.048
Group by Set by Time	1, 16	1.62	.221
Set by Time	1, 16	.98	.338

SILS Vocabulary

Source	DF	F	Significance
Group by Gender	1, 30	.35	.559
Gender	1, 30	.00	.971
Group	1, 30	5.64	.024
Group by Gender by Set	1, 31	2.91	.098
Gender by Set	1, 31	.50	.484
Group by Set	1, 31	.38	.544
Set	1, 31	34.41	.000
Group by Gender by Time	1, 31	.38	.544
Gender by Time	1, 31	2.50	.124
Group by Time	1, 31	.21	.649
Time	1, 31	19.24	.000
Group by Gender by Set by Time	1, 31	2.89	.099
Gender by Set by Time	1, 31	2.13	.155
Group by Set by Time	1, 31	2.45	.128
Set by Time	1, 31	.98	.330

Table 15 (Continued)

Supplementary ANCOVAs for All Analyses

Second Analysis

EAS Symbolic Reasoning

Source	DF	F	Significance
Group	1, 7	1.13	.322
Group by Set	1, 8	1.44	.264
Set	1, 8	6.79	.031
Group by Time	1, 8	1.10	.326
Time	1, 8	1.04	.338
Group by Set by Time	1, 8	.01	.921
Set by Time	1, 8	.36	.566

EAS Verbal Reasoning

Source	DF	F	Significance
Group	1, 7	1.83	.218
Group by Set	1, 8	.28	.614
Set	1, 8	.15	.712
Group by Time	1, 8	.08	.788
Time	1, 8	1.44	.265
Group by Set by Time	1, 8	.26	.622
Set by Time	1, 8	.01	.929

SILS Abstraction

Source	DF	F	Significance
Group	1, 7	2.14	.187
Group by Set	1, 8	1.18	.308
Set	1, 8	15.40	.004
Group by Time	1, 8	2.33	.166
Time	1, 8	.00	.977
Group by Set by Time	1, 8	.00	.975
Set by Time	1, 8	.22	.651

(Table Continues)

Table 15 (Continued)

Supplementary ANCOVAs for All Analyses

	Third Analysis		
	SILS Vocabulary		
Source	DF	F	Significance
Group	1, 7	.28	.615
Group by Set	1, 8	.45	.521
Set	1, 8	5.18	.052
Group by Time	1, 8	2.71	.138
Time	1, 8	23.87	.001
Group by Set by Time	1, 8	7.34	.027
Set by Time	1, 8	8.09	.022

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